AVIATION WEEK

A McGRAW-HILL PUBLICATION

vember 5, 1956 50 cents

Dramatic Rescue Of NACA Pilot From Bell X-1A

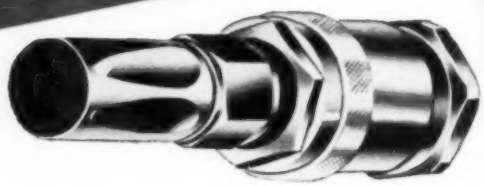
Sikorsky S-58

Tools and Gages Are Vanguard Key

if it's got to connect ...

CONNECT WITH WIGGINS

The authority on connectors.
Engineered for reliability.



Connect - O - matic
Trademark

An automatic connector.
PUSH . . . it's connected.

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Flexible union for connecting rigid tubes.

Inst - O - matic
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Quick Disconnect

Break-away

Wiggins

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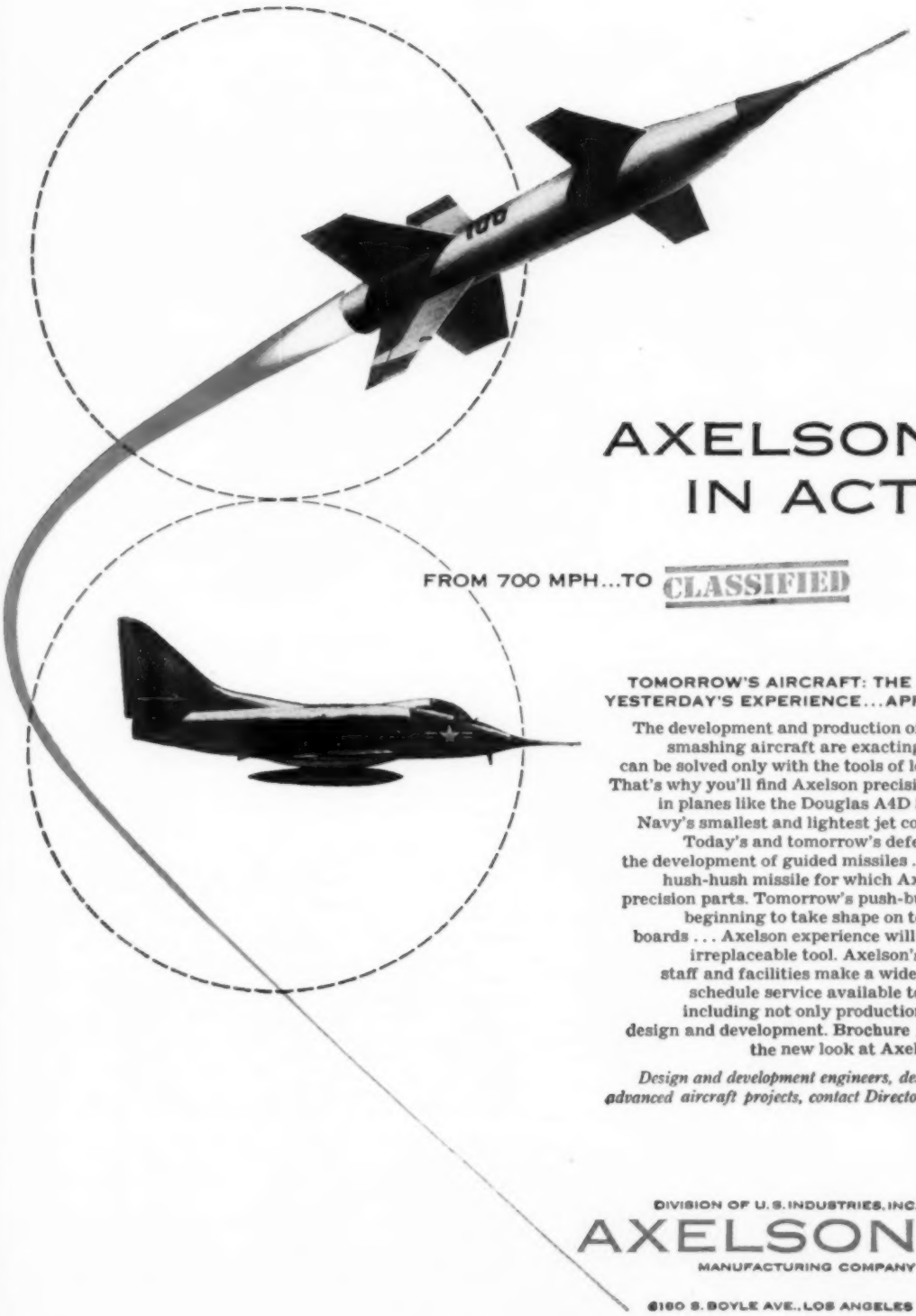

AXELSON IN ACTION

FROM 700 MPH...TO CLASSIFIED

TOMORROW'S AIRCRAFT: THE PRODUCT OF YESTERDAY'S EXPERIENCE...APPLIED TODAY.

The development and production of today's Mach-smashing aircraft are exacting problems that can be solved only with the tools of long experience. That's why you'll find Axelson precision components in planes like the Douglas A4D Skyhawk —the Navy's smallest and lightest jet combat airplane. Today's and tomorrow's defense is linked to the development of guided missiles . . . ones like the hush-hush missile for which Axelson produces precision parts. Tomorrow's push-button arsenal is beginning to take shape on today's drawing boards . . . Axelson experience will again prove an irreplaceable tool. Axelson's new, enlarged staff and facilities make a wider variety of on-schedule service available to the industry—including not only production, but research, design and development. Brochure AA-6 describes the new look at Axelson. Ask for it!

Design and development engineers, desiring to work on advanced aircraft projects, contact Director of Engineering.

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AXELSON MANUFACTURING COMPANY

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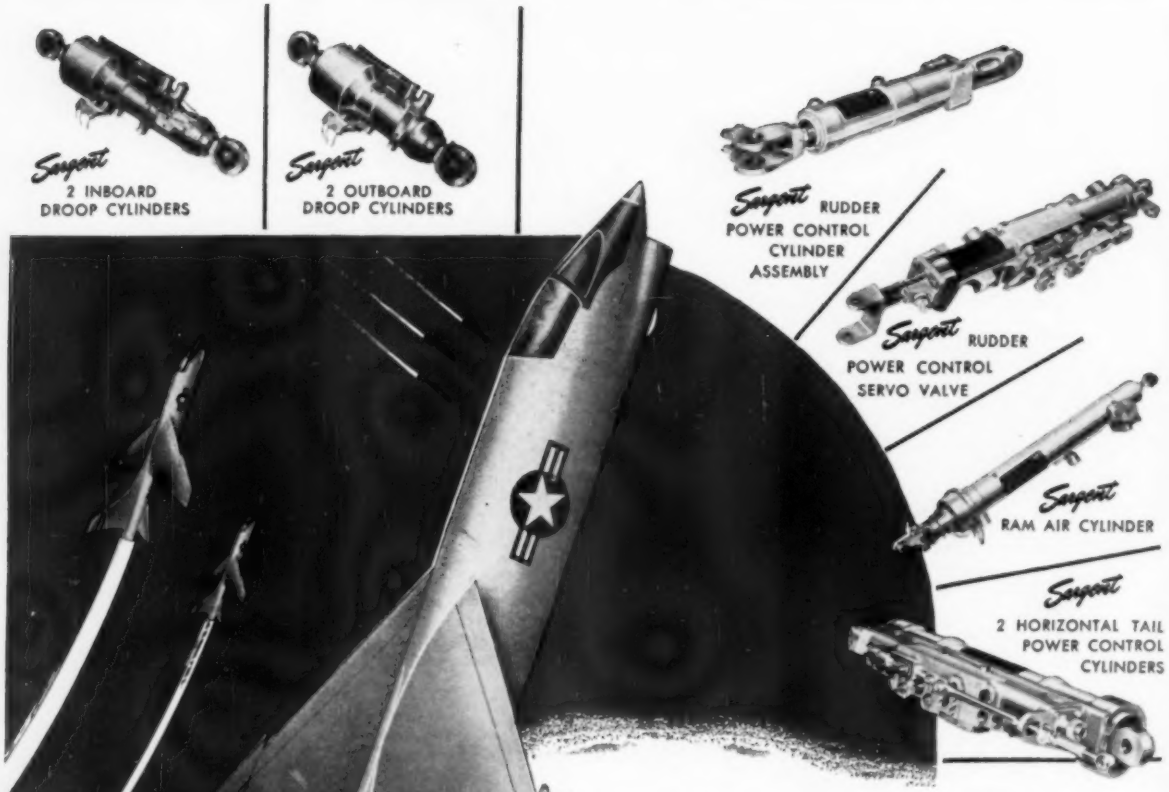

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9 Proudly wears Sargent controls

Nine Sargent quality units have been selected to provide Chance Vought's F8U-1 Crusader with instantaneous, positive, feathertouch response.

These units, Sargent fabricated to Vought specifications, provide a system for control for the safe, positive, efficient operation of this great fighter.

The experience of more than 36 years of design and manufacture of precision equipment systems has given Sargent Engineering Corporation the "know-how" to aid in solving the essential and advance problems of force control. Leading airframe and missile manufacturers are using hundreds of different Sargent hydraulic, mechanical, pneumatic, electrical and electronic force control units on the nation's military planes, commercial planes and missiles.

Sargent places its facilities of design and manufacture at your disposal. We invite you to send your specifications for the Sargent proposal of your force control problems.

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D WILL" [illegible] pleased [illegible] ne place [illegible] ll treated.

— U[illegible] Supreme Court

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BUILDS QUALITY THAT BUILDS GOOD WILL

AVIATION CALENDAR

Nov. 12-15—Thirty-Sixth Annual Meeting, American Petroleum Institute, Hotels Conrad Hilton, Palmer House and Sheraton Blackstone, Chicago, Ill.

Nov. 13-14—Sixth Transport Aircraft Hydraulic Conference, sponsored by Vickers, Inc., Park Shelton Hotel, Detroit.

Nov. 14-16—Symposium on Optics and Microwaves, sponsored by the Institute of Radio Engineers Professional Group on Antennas and Propagation, Lisner Auditorium, George Washington University, Washington, D. C.

Nov. 14-16—Latin American Aviation Conference, sponsored by Export Committee, Aircraft Industries Assn., Miami, Fla.

Nov. 14-16—Jet Engine Overhaul Symposium, General Electric Co., Evendale, Ohio.

Nov. 15—Conference on problems and issues concerned with control and protection of airport approaches, sponsored by Institute of Transportation and Traffic Engineering, University of California, International House, University of California, Berkeley, Calif.

Nov. 15-16—Guided Missile Branch and Committees, American Ordnance Assn., Naval Ordnance Test Station, Inyokern, Calif.

Nov. 15-16—Metropolitan New York Material Handling Conference, sponsored by N. Y. Chapter of the American Material Handling Society, Brooklyn Polytechnic Institute, Brooklyn, N. Y.

Nov. 16-17—Air Mail Pioneers Eastern Division Reunion, Ambassador Hotel, Washington, D. C.

Nov. 25-27—Aviation Distributors & Manufacturers Assn., 28th Meeting, Drake Hotel, Chicago, Ill.

Nov. 25-30—Aviation Division, American Society of Mechanical Engineers, Annual Meeting, New York City.

Nov. 26-27—International Meeting Canadian Aeronautical Institute and the Institute of the Aeronautical Sciences, Royal York Hotel, Toronto, Ontario.

Nov. 26-30—Human Engineering Conference, Third International Automation Exposition, Trade Show Building, New York City.

Nov. 29-30—Society for Advancement of Management Operations Research Conference, Hotel Commodore, New York City.

AVIATION WEEK • NOVEMBER 5, 1956
Vol. 65, No. 19

Published weekly with an additional issue in December by the McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices: 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A. Gerardi, Executive Vice President and Treasurer; Hugh J. Kelly, Executive Vice President; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publication Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; J. E. Blackburn, Jr., Vice President and Circulation Director.

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Single Copies 50¢. Subscription rates—United States and possessions, $6 a year; $9 for two years; $12 for three years. Canada $8 a year; $12 for two years; $16 for three years, payable in Canadian currency at par. Other Western Hemisphere and the Philippines $10 a year; $16 for two years; $20 for three years. All other countries $20 a year; $30 for two years; $40 for three years. Second class mail privileges authorized at Albany 1, N. Y. Printed in U. S. A.

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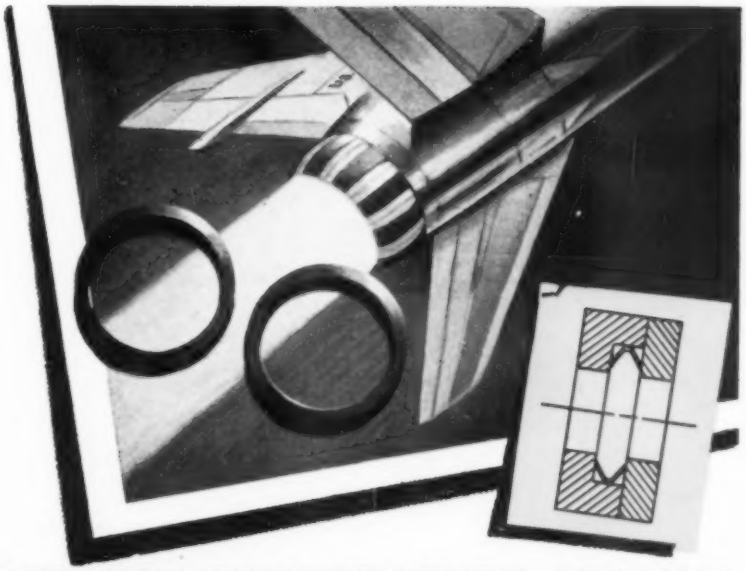

RED-HOT TEMPERATURE SEALING SOLVED BY V-FACE SEALS

Now used in jet engine fuel systems, Fulton Sylphon V-FACE Seals demonstrate their long-lasting resistance to extreme temperatures every time a super-powerful jet swishes overhead. One second they shrug off red-hot temperatures of 800° F. The next minute they flaunt sub-freezing temperatures of -65°F. Every minute they battle high pressures up to 1000 psi.

Fulton Sylphon V-FACE* Seals offer this same unfailing resistance to extremely high and low temperatures in hydraulic systems, pneumatic ducts, and other flat surface sealing applications.

For extra-tight sealing of cylindrical surfaces, Fulton Sylphon also designs and manufactures job-fitted Reed and Vee type seals in Nylon, Teflon, Inconel X, stainless steel, and other materials. With them, you can obtain long-lasting sealing and economical re-sealing of fluids or gases at pressures to 30,000 psi and temperatures from -100° F. to 1200° F.

*formerly called Flat Seals

ANOTHER NEW IDEA FROM **FULTON SYLPHON**

SEND TODAY FOR 16-PAGE BULLETIN VA-827

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FULTON SYLPHON DIVISION · Knoxville 1, Tenn.

Vickers Servo Pump Systems

Provide rapid and accurate response to minute electrical or mechanical signals

The Vickers Servo Pump Unit shown at the right is a signal-controlled, variable delivery, positive displacement, reversible flow oil hydraulic pump. In combination with a rotary or linear hydraulic motor, it forms a signal-controlled hydraulic transmission for remote control operations and high-response servo systems.

The servo transmission may be considered as a power amplifier when viewed from the electrical signal input, of about five watts, to the mechanical power output of several thousand watts. Various sizes of transmissions have been built, having output capacity ratings from one to four hundred horsepower. The servo pump develops only that pressure required to move the load . . . which means reduced pressure over the greater part of the system life since peak loads occur only infrequently in the majority of systems. This greatly reduces power losses and minimizes heat rejection.

Any type of prime mover of sufficient capacity can be used to furnish the power input . . . electric motor, auxiliary drive pad on an airplane engine, air turbine, hydraulic motor, etc. Substantially constant speed is desirable.

Variable Pump Volume Controlled by Signal

Heart of the servo pump unit is the Vickers Variable Stroke Hydraulic Pump. This is usually a nine-cylinder pump housed in a pintle-mounted yoke. Varying the yoke angle varies piston stroke, hence, output volume from zero to maximum in either direction of flow. A stroking piston actuated by a pilot valve varies the yoke angle according to signal.

Low Control Power Requirement

Power for control purposes is low in a servo pump unit because metering valve action is confined to the volume-regulating system which is a low power level (100 to 300 psi) hydraulic system separate from the power transmission hydraulic circuit although a part of the pump unit. This volume-regulating system controls piston displacement and direction in the power pump which can operate at pressures up to 3000 or 4000 psi. Pressure drop across ports of a metering valve, with its inherent losses, is avoided in the power transmission system. Final power output from the pump is determined by the volume of flow which the volume-regulating system demands and by the actual resistance of the load . . . is not dependent upon pressure drop methods of control.

In a control system employing this servo pump, the variations in gain resulting from load change are negligible compared to those which may occur in a similar circuit controlled by a valve metering directly in the power line.

Constant Displacement Hydraulic Motor

Flow and pressure generated in the hydraulic pump are carried by tubing with no intermediate valving to the hydraulic motor or linear actuator. The fixed stroke hydraulic motor provides torque directly proportional to pressure and speed directly proportional to flow rate.

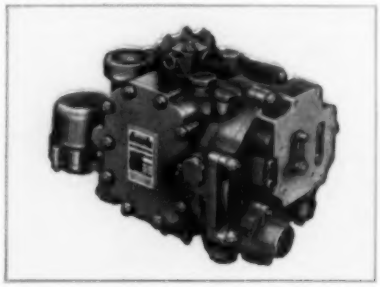
High Power-to-Weight Ratio

The servo pump unit and its associated hydraulic motor are designed for high power-to-weight ratio, high torque-to-inertia ratio, low inertia of rotating parts, and high resonant frequency.

Typical Example

High power-to-weight ratio—3.76 hp/lb (motor only)
High torque²-to-inertia ratio—3.5 x 10^7 lb-in./sec²
Low inertia of rotating parts— .052 lb-in.²
High resonant frequency— 20 cps (entire system)

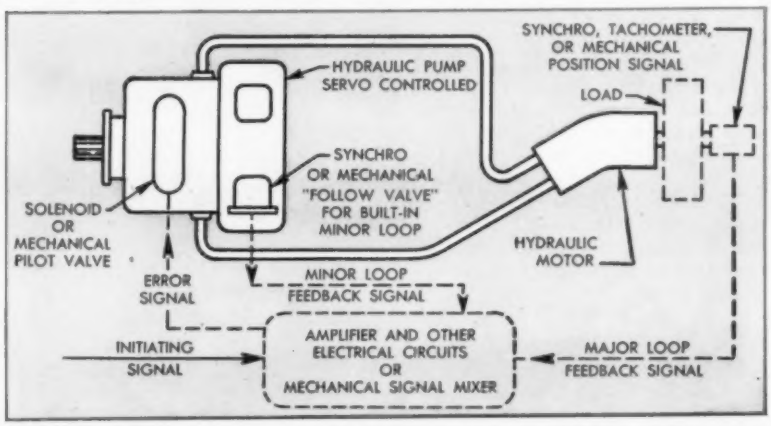
Other advantages are reliability and versatility of application. The smooth,



stepless speed changes and ability to hold position against any variation in load are additional reasons why this unit is a desirable resource which can solve many design problems.

Important among the applications of Vickers Servo Pump Units is extremely fast and accurate positioning of gun turrets on aircraft. Another is actuation of the exhaust nozzle for jet engines; here the servo pump's characteristic of providing at all times only sufficient power to meet the momentary demand minimizes the power loss and therefore the heat rejection. The greatly reduced average pressure level in this type of system prolongs the life and improves the reliability of all components.

For further information, ask for Bulletins SE-15 and SE-18 or get in touch with your nearest Vickers Aircraft Application Engineer. He can arrange for an engineering team to consider your problem and propose an optimum solution.


SYNCHRO, TACHOMETER, OR MECHANICAL POSITION SIGNAL
HYDRAULIC PUMP SERVO CONTROLLED
LOAD
SYNCHRO OR MECHANICAL "FOLLOW VALVE" FOR BUILT-IN MINOR LOOP
SOLENOID OR MECHANICAL PILOT VALVE
HYDRAULIC MOTOR
ERROR SIGNAL
MINOR LOOP FEEDBACK SIGNAL
INITIATING SIGNAL
AMPLIFIER AND OTHER ELECTRICAL CIRCUITS OR MECHANICAL SIGNAL MIXER
MAJOR LOOP FEEDBACK SIGNAL

SIMPLIFIED DIAGRAM illustrates a servo control system employing Vickers Servo Pump Unit and Constant Displacement Hydraulic Motor. This system accepts initiating signals (either electronic or mechanical, depending on type of system), compares them with feedback signals from load and (through controlled changes in direction and volume of fluid pumped to motor) corrects the load as required. For added accuracy and stability, a minor loop providing signals proportional to rate of flow may be added. This may either be built into the pump in the form of a mechanical "follow valve" which results in modulating the flow as a function of the net signal to the pump, or may be a synchro which feeds a signal proportional to flow rate into the amplifier. The controlled output may be either a function of the position or velocity of the load.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
ADMINISTRATIVE and ENGINEERING CENTER
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Stackpole Fixed Composition Resistors are stocked by leading parts distributors

U. S. Army Photo

AA Fire Control System T50 mounted on "Duster", the Army's twin 40mm self-propelled vehicle M42. This is a major advance in control of fire for this weapon.

FRANKFORD ARSENAL IS ARMY'S CENTER FOR ORDNANCE WEAPONS FIRE CONTROL SYSTEMS

This "Old Line" Arsenal in Philadelphia is a key member of the Army-Ordnance-Industry team. Since World War II it has been rapidly converting from a manufacturing installation to a research and development center responsible for national direction or major support of Ordnance ammunition and weapons programs, chemical, metallurgical, and ballistic research, and gage design and supply.

The major operating organizations of Frankford are the Pitman-Dunn Laboratories Group, the Ammunition Group, the Gage Laboratory, and the Fire Control Instrument Group. The latter is a small arsenal in itself, consisting of research and development, industrial procurement and production, and field service elements. Working with weapons systems contractors in private industry, its scientists and engineers have been responsible for successful application of optical range finders to tanks, for the Skysweeper AA System and the AA Fire Control System M33. Today, Frankford maintains close relations with the Army Ballistic Missile Agency and Redstone Arsenal for the solution of guidance problems. Recently this group has applied radar ranging to the twin 40mm self-propelled light AA gun, the "Duster", enlarging this weapon's capabilities for dealing with high-speed, low flying aircraft.

That segment of industry interested in fire control instruments, ammunition components, and recoilless weapons relies for definition of the problem, and allocations of programs, on Frankford Arsenal, whose goal has been defined as Total Technical Teamwork.

This is one of a series of ads on the technical activities of the Department of Defense.

109

FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION

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Beverly Hills, Cal. • Dayton, Ohio

Engineers at Ford Instrument Company working on a design of a special Anti-aircraft project.

ENGINEERS

of unusual abilities can find a future at FORD INSTRUMENT COMPANY. Write for information.

One of a kind!

Kids still love jacknives, but no longer seem to do much whittling. Like the circus big-top this vanishing pastime seems to be one more casualty of this high-G, triple-carburetion age.

The production engineer also has lost his enthusiasm for whittling metal. Machining from solid bar is still a necessity when making one part or a few prototypes. But, for hundreds of parts, extruded shapes save metal and machining time.

TMCA has pioneered the difficult art of extruding Titanium alloys. Many thousands of pounds of extruded Titanium sections are regularly shipped to jet engine and airframe industries. Seamless extruded tubing is another regular production item at TMCA.

Write today for information on Titanium extruded shapes and tubing.

. . . FIRST IN Titanium.

TITANIUM METALS CORPORATION OF AMERICA, 233 Broadway, New York 7, N.Y.

They used to remove a section of the deck to get a radar switchboard inside a submarine. Now it fits easily through a hatch because Admiral has redesigned the unit to reduce bulk and weight by as much as two-thirds!

This priceless saving in pounds and inches is only one of the new unit's many advantages. Formerly up to 400 man-*hours* were needed for major repairs such as replacing a defective switch section. Now the job is done in 20 *minutes!* The entire unit is built up of standardized sub-assemblies fitted with multiple connector plugs. It is a simple matter to remove and replace a faulty switch or amplifier. Each switch section even has its individual power supply to keep the switchboard operable in case one section goes out. The unit can be readily expanded to handle additional radar indicators by simply adding more self-contained sections. Printed switches and circuit boards, designed for automation assembly, are ruggedly resistant to vibration and humidity.

The radar switchboard, for use on all types of naval vessels, is typical of Admiral's advanced design, research and development in electronics, now being carried forward for all branches of the Armed Services.

Admiral.
CORPORATION

Government Laboratories Division, Chicago 47

LOOK TO *Admiral* FOR
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IN THE FIELDS OF:

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ELECTRONIC COUNTER MEASURES

Facilities Brochure describing Admiral plants, equipment and experience sent on request.

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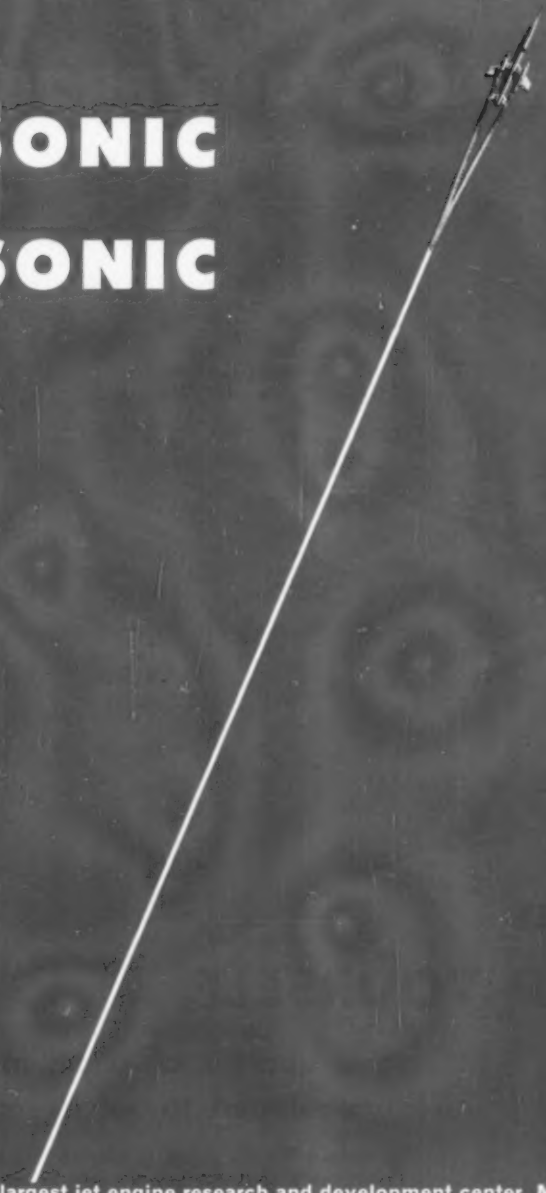

What's beyond?—Here, at the West's largest jet engine research and development center, Marquardt's newly created research division is already probing into the most advanced concepts of supersonic and hypersonic flight, researching new chemical fuels and nuclear energy, integrating advanced propulsion schemes with aerodynamic requirements.

To continue this research, effectively, we need additional qualified research scientists and engineers in supersonic and hypersonic flight and related fields. We need explorers looking for a future in an atmosphere of individual professional development and continued academic training. We need men who are right now saying to themselves, "What's beyond?".

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MARQUARDT AIRCRAFT COMPANY, Research Division

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then HELP YOURSELF

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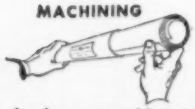

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to a quarter of a million square feet equipped to solve your problem

American Welding has a quarter of a million square feet of floor space that houses the equipment necessary to manufacture production runs of welded rings (made from rectangular bars or special mill shapes) or circular weldments — from 6″ to 96″ in diameter, of ferrous or non-ferrous metal.

And that's not all — 900 specialists in ring manufacture are backed with the best in engineering and research — with heat treating, x-ray and test equipment required to meet aircraft specifications.

Let Amweld become your production welded ring department.

THE AMERICAN WELDING & MANUFACTURING CO.
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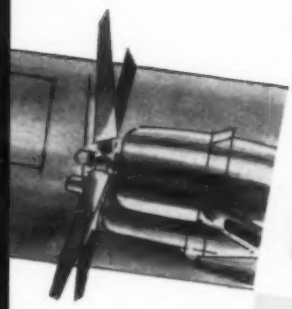
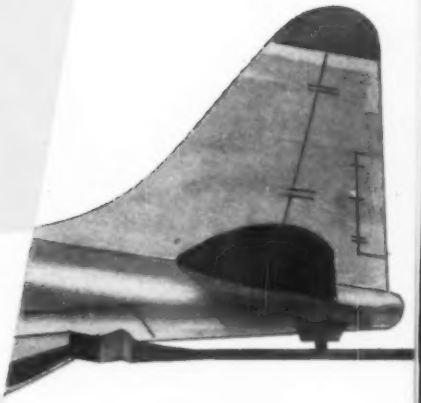


From Prop to Tail



Hayes has proved by performance that the Company knows modern aeronautical design, fabrication, assembly, and flight testing of modified aircraft of all kinds and sizes.

Hayes has the necessary facility, the engineering and technical staff, the tooling, financial structure, cost control system, man-power and the know-how. Hayes thus occupies a unique position in the aircraft industry.

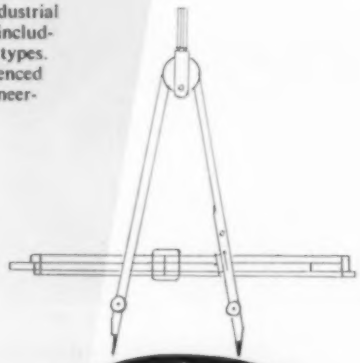
Hayes position is one of special service in a field of activity *between the prime manufacturer and the overhaul shop.*

By this unique service, Hayes completely modernizes and gives new functional performance potentials to such aircraft as the B-50, KC-97, B-25, C-119, and others which are in good condition but have outlived their original usefulness in view of modern requirements for National Defense.

The "clincher" is that Hayes performs this service at a great savings compared to the cost of similar new planes

AIRCRAFT ENGINEERS WANTED

With over 8,000 employees, Hayes is a competitive industrial facility for modification and maintenance of aircraft, including guided missile work and engineering design of all types. Opportunities are open for aeronautical scientists, experienced aircraft design engineers, and graduate students in engineering. Write Personnel Department.



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Hayes
AIRCRAFT CORPORATION
BIRMINGHAM, ALABAMA

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Packaged landing gear for Lockheed's *Electra*

Score Another First for Menasco!

The nose and main landing gear produced by Menasco for the Lockheed Electra will be delivered as complete pre-tested, functional systems, ready for installation in the airframe. This includes tires, wheels, brakes, steering system, wiring, plumbing, gear-mounted valves and switches.

It is fitting, too, that the Electra, America's first turbo-prop airliner, utilizes the latest advance in landing gear design and manufacture – Uniwelding of high heat treat steels – a combination pioneered and offered exclusively by MENASCO, specialists in aircraft landing gear.

First in development, quality, delivery and service

menasco manufacturing company

805 South San Fernando Boulevard, Burbank, California

SPECIALISTS IN AIRCRAFT LANDING GEAR

Typical Cutler-Hammer Hermetically Sealed Relay with protective terminal cover available on all relays in the line

Cutler-Hammer Hermetically Sealed Relay Family is Growing Steadily

The line of Cutler-Hammer Hermetically Sealed Aircraft Power Relays is constantly being extended with new types and capacities. They reflect the years of intensive development and research by Cutler-Hammer engineers in close cooperation with leading aircraft builders. Designed for use in higher ambient temperatures and better able to withstand shock and vibration, they meet both present and future needs for environment-free dependability. They offer longer life and contribute directly to increased safety.

Only permanent non-aging materials are used. All metal parts (except those carrying current or those in the magnetic structure) are stainless steel. The stainless steel case is covered *both outside and inside* with a special blue glass fused thereto at extremely high temperatures. This special glass is chip-proof and has great dielectric strength with maximum recovery should a flashover occur.

These new relays are standardized to be generally interchangeable with presently-used unsealed relays. As this advanced line is being extended continuously as to types and capacities, be sure you have the latest data. Write on your company letterhead for the 1956 edition of CUTLER-HAMMER AIRCRAFT ELECTRICAL CONTROL, Pub. EE-140. CUTLER-HAMMER, Inc., 1471 St. Paul Ave., Milwaukee 1, Wis.

Cutler-Hammer Leadership in Aircraft Control

Cutler-Hammer has long held the respect of the aircraft industry because this company has been *part* of the aircraft industry for 35 years. It has never been an opportunist supplier. It has *pioneered* the designs others have followed. It has sought to serve, not merely sell. It has been in the forefront of all co-operative activity in standardization and long-range planning. It has supplied complete lines of equipment, not merely the items of widest use and most profitable manufacture. Today, as for the decades past, Cutler-Hammer engineers are working closely with the aircraft industry's leaders . . . thinking ahead, planning, designing and building for the future.

Here is the record:

1920 Cutler-Hammer designed and manufactured the first line of switches ever created specifically for use in aircraft.

1938 Cutler-Hammer designed and manufactured the first d-c power relays ever created specifically for use in aircraft.

1943 Cutler-Hammer designed and manufactured the first a-c power relays ever created specifically for use in aircraft.

1949 Cutler-Hammer started development of the first environment-free power relays for use in aircraft.

1953 Cutler-Hammer submitted samples and certified test reports on the first hermetically sealed power relay to WADC and Bu. Aer. Cutler-Hammer configuration was adopted as industry standard by ASG.

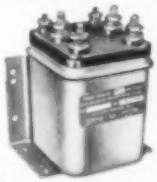
1955 Cutler-Hammer designed and manufactured the first one hole mounting Lever Lock aircraft switches.

50 amp. single pole, single throw Class A power relay.

200 amp. single pole, single throw Class B power relay with N.O. and N.C. interlocks.

25 amp. three pole, single throw Class B power relay with N.O. and N.C. interlocks.

100 amp. three pole, single throw Class B power relay.



50/25 amp. single pole, double throw Class B power relay.

25 amp. three pole, double throw reversing duty Class B power relay.

Cutler-Hammer Power Relays—Finest in Flight

Cutler-Hammer Hermetically Sealed Relays are designed to meet Spec. Mil. R. 6106B (A.S.G.). Operate at 80,000 feet. Class A in ambient temperatures to 71° C, withstand vibrations 10 to 500 cps, 10g. Class B in ambient temperatures to 120° C, withstand vibrations much higher than 500 cps.

CUTLER-HAMMER
AIRCRAFT CONTROL
C-H

B.F.Goodrich
selected by Lockheed

B. F. GOODRICH BRAKE *stop is recorded on oscilloscope film. Notice smoothness of line during stop.*

CONVENTIONAL DISC BRAKES *record this jagged line. The torque variations cause roughness and chatter.*

wheels and brakes for propjet Electra

EXCEPTIONAL requirements had to be met in choosing a brake for Lockheed's new Electra, America's first propjet airliner. The Electra embodies a new concept of smoothness—in flight and during landings. It will operate economically with minimum off-time for maintenance. And, for intermediate flights, it will be able to land safely on existing runways.

That called for a brake that would operate with outstanding smoothness, give long service and handle the higher kinetic energies generated by faster, shorter stops. For these and many other reasons, Lockheed selected the new B. F. Goodrich disc-type brake.

B. F. Goodrich engineered the new brake-wheel unit using sintered metal linings and latest "bucket" wheel design. Tests showed Lockheed the unit has great strength with minimum weight and the highest combination of smooth stopping ability and long wear.

New two-way automatic adjustment maintains constant lining clearance regardless of service wear. This gives the pilot better ground control because the brakes always react the same way to pedal pressure. By eliminating periodic adjustment, maintenance time is reduced.

The photos show one of many dynamometer tests made to compare performance of new B. F. Goodrich brakes with that of conventional disc types. These tests simulated landings of the Electra at varying speeds up to and including a 162 mph emergency "refused take-off" stop. In all cases, the B. F. Goodrich brake provided smooth, quick stops without destructive vibration or chatter.

Because of its exceptional stopping ability and long life, this new brake is now being considered by other airframe manufacturers for future planes. If your designers would like to discuss technical details, contact:

B.F.GOODRICH ENGINEERS *man controls of 250 mph dynamometer.*

B.F.Goodrich

AVIATION PRODUCTS

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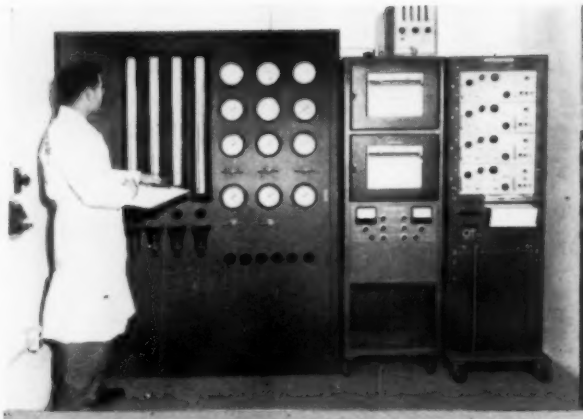
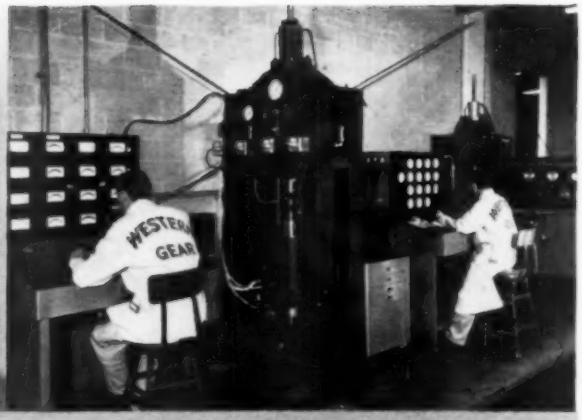
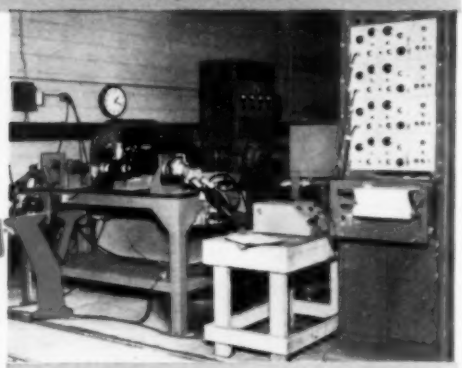


Instrumentation for guided missile test cell



Production testing linear actuators

how WESTERN GEAR insures RELIABILITY



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5633

NOVEMBER 5, 1956

AVIATION WEEK

VOL. 65, NO. 19

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BUSINESS MANAGER.....J. G. Johnson
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RESEARCH AND MARKETING

Mary Whitney Fenton, Joan Read, Judith P. Wheeler

USAF Reveals New X-2 Crash Details 26
► High-speed pitching caused pilot to eject capsule; blackout prevented final steps to safety.

CAA Details Results of Collision Tests 38
► General acceptance of proximity-warning devices needed to ease threats of mid-air collisions.

Vanguard Depends on Gages 51
► Tools and gages will determine whether the Vanguard will be a satellite or a meteor.

Heroism Marks X-1A Accident 111
► Eight NACA employes and a USAF pilot receive awards for dramatic rescue of pilot Joseph A. Walker.

MISSILE ENGINEERING

Army Expands Missile Scope 32
Mach 10 Rocket and Boosters 53
GE Opens Lubricant Center 55
Public Sees Atomic Delivery 57

AERONAUTICAL ENGINEERING

Hustler May Fly This Week 29
Second P6M Modified 31
XV-3 Convertiplane Crashes 31
French Trident 2s 34
C-130 Combat Tested 37
Fiat-Built F-86K in Service 79
What's New 83

HUMAN FACTORS

Design Can Be Key to Survival 61
Crash Manual Available 62

AVIONICS

CAA Needs Radar Display 33
UAL Orders Proximity Radar 43
UHF-VHF Range May Triple 87
Novel Radar Stand 99
Omnirange Receiver 101
Filter Center 101
New Avionic Products 105

BUSINESS FLYING

Specialized Farm Planes 134
Maine Promotes Industry Airports 137
New Zealand Spray Planes 137
Private Lines 137

TRANSPORT

Tu-104 Sets New Record 39
Boeing 707 in BOAC Colors 39
New Braniff, Delta Routes 40
Airlines and Mid-East Conflict 41
Controllers Propose Integration 43
U. S. Colombia Bilateral 43
PAA Tourist Plan Rejected 43
Midway Busiest 43
Local Airline Gets Braniff Routes 45
Two Nonskeds Ousted by CAB 45
Mackey-Midet Merger Approved 45
Shortlines 45
Airline Observer 47

SAFETY

Details of F-11F Accident 30

MANAGEMENT

Horner Recommends More R&D 27
Wilson Confirms WS-110A 28
USAF Gets Sidewinder 28
De Havilland Plans Transport 29
Hawker Finances New Fighter 29
Bell Reorganizes 29
CAA's Pyle on Instruments 33
Argentina Builds T-34 33
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 33

Calendar 5
Letters 158

EDITORIAL

Spearhead of Progress 21

COVER: Twelve-passenger Sikorsky S-58 Skybus, latest addition to New York Airways fleet of helicopters used on scheduled passenger, cargo and mail service, cruises up the Hudson River at 1,500 ft. NYA has three S-58s, operates two on regular shuttle service between Newark, LaGuardia and N. Y. International airports. One S-58 is retained on standby. Operation of the S-58 into New York's 30th St. West Side Heliport (AW Oct. 15, p. 43) is expected to begin next spring, by which time the aircraft will be fitted with emergency flotation gear.

67,816 copies of this issue printed

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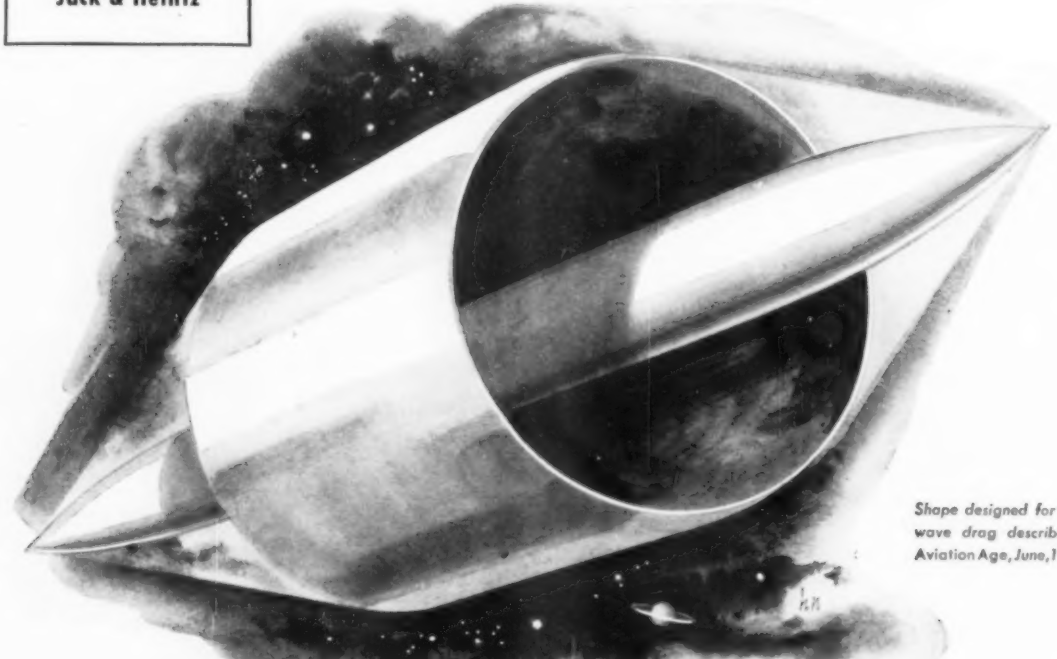
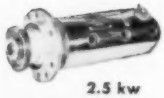


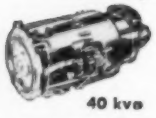
Shape designed for zero wave drag described in Aviation Age, *June, 1956.*



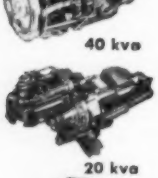
2.5 kw

12.3 kw

100 amps



40 kva



20 kva

17 kva

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Volts	d-c 3 outputs	a-c, d-c 3 outputs	30	120/208	120/208	120/208
Speed (rpm)	12,000	12,000	8,000	6,000	8,000	12,000
Phase (cps)	—	—	—	3	3	3
Frequency (cps)	—	1,600 400	—	400	400	400
Power Factor (min)	—	—	—	.75	.75	.75
Weight (lb)	30	70	36¼	165*	100*	50
Length (in.)	12.71	14.3	10.57	27.25*	26.0*	12.85
Diameter (in.)	4.5	7.75	6.5	13.0*	9.5*	7.5

*Includes Integrated Constant-Speed Drive

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JACK & HEINTZ AIRCRAFT ELECTRIC EQUIPMENT

EDITORIAL

Spearhead of Progress

The recent industry-military inspection of the National Advisory Committee for Aeronautics Laboratory at Langley AFB, Va., was a dazzling display of new research facilities and techniques actively exploring areas that, until a few years ago, were considered strictly within the realm of science fiction writers. Even the most technically sophisticated of the 1,600 engineers, executives, scientists and military airmen who saw the Langley display must confess to some astonishment at the variety of research tools revealed and the areas in which NACA is using them.

Good Leadership

NACA's performance as a spearhead of aeronautical progress in this country has been so consistent that its industry and military beneficiaries and the American public tend to take the committee's contributions for granted. Therefore, it may not be amiss to detail some of the hard, brilliant and expensive effort that has been necessary to produce the results with which NACA has laid a solid foundation of new research tools, techniques and data for the successful development of supersonic aircraft and hypersonic missiles.

One of the basic ingredients in the NACA formula is, of course, good men, both at the level of top leadership and on the firing line in the laboratories. Dr. Jerome C. Hunsaker, who has been chairman of NACA during the 15 critical years since the outbreak of World War II, has combined the practical experience of an aviation pioneer with a breadth of vision that saw clearly the needs of aeronautical research through the hypersonic range. Dr. Hugh L. Dryden, director of NACA since 1948, combines the talents of a scientist who made basic contributions on boundary layer control and turbulence with the administrative flexibility required to keep this organization hard at work on new frontiers and out of the rut of complacency.

Need New Tools

In the laboratories, NACA has been fortunate to retain the loyalty and enthusiasm of a host of men who could easily command much higher monetary rewards in private industry. Listing all of them would run far beyond the confines of this space, but typical are John Stack at Langley, a catalyst in the high-speed flight research program, inventor of the transonic wind tunnel and teacher of a brilliant crew of young researchers, including Dick Whitcomb and his area rule; Charles Zimmerman, persistent pioneer in STOL concepts; R. T. Jones of Ames, originator of the swept-wing concept in this country; Harvey Allen, with his fundamental work on missile nose cones; Bob Gilruth, whose multi-stage, rocket-powered models pioneered a new research technique at Wallops Island; Abe Silverstein of Lewis, basic researcher on rockets, ramjets, turbojets and nuclear propulsion; Irving Pinkel, dedicated to safety research, and Walter Olson on fuels.

One of the basic problems of aeronautical researchers, as distinguished from those of explorers concerned with earth or water-bound vehicles, has been the difficulty of simulating the fantastic environment encountered and the forces generated by high-speed flight. In this field, NACA has developed a wide variety of clever concepts combined with practical ironmongery and pottery to produce basically new research tools for simulation of the high speed flight environment. Even before most of these new research tools were developed, NACA was a moving spirit in pushing development of high-speed flight research aircraft such as the Bell X-1 and X-2 and the Douglas D-558 Mark I and II.

It was no accident that this country was the first to put a level flight supersonic fighter into service; the first to put into production a Mach 2 fighter, and the first to push the limit of piloted flight to 126,000 ft. altitude and beyond 2,000 mph. NACA deserves no small share of the credit for our jump into the supersonic lead.

Proud Record

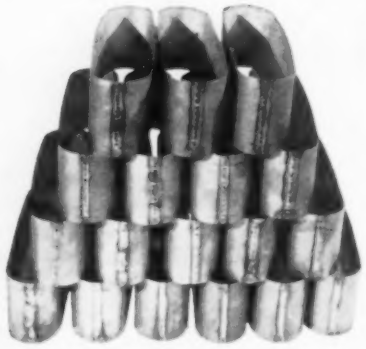
In addition to its basic job of fundamental research and development of tools and techniques to do this job, NACA also has functioned in the role of a technical trouble-shooter called on repeatedly by the military and industry to iron out major bugs in new aerial weapon systems. NACA is overly modest about its achievements in this field and perhaps it should be in the interests of maximum effectiveness, but there is hardly an airframe or engine maker in this country who has not benefited directly from this type of NACA work. Now, as an operator of unitary plan wind tunnels for industry development work, NACA is expanding its contribution in this field.

Like all research organizations, NACA finds its work is never finished. Every major discovery or breakthrough merely opens a new frontier that must be explored and breeds a new family of problems that must be solved. This is a characteristic of its job that NACA always finds difficult to explain to members of the Congress concerned with its annual appropriations and its never-ending need for new types of research facilities.

NACA is a vital part of the great American aeronautical research complex that includes the Air Research and Development Command, the Office of Naval Research and the research organizations of universities and private industry. It can be justly proud of its record during the past 15 critical years in the air. The American people and the aircraft industry can look forward with confidence to its aggressive and skillful attack on the aeronautical problems of the future.

—Robert Hotz

Martin designers make good use of REM-CRU titanium's excellent welding qualities. These welded titanium sleeves are used to support ducting as it passes through bulkheads aboard the SeaMaster.



why Rem-Cru TITANIUM *flies with the* SeaMaster

Corrosion resistant TITANIUM parts, aboard the new Martin P6M SeaMaster, save vital pounds without sacrifice of strength. It's one of the reasons why this Navy attack seaplane can leave the water with a 30,000-pound payload, and cruise at over 600 mph.

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WHO'S WHERE

In the Front Office

James G. Felsenthal, corporate secretary and assistant sales manager, elected a director of G. Felsenthal & Sons, Inc., Chicago.

Sir Ralph Sorley, managing director, appointed deputy chairman of de Havilland Propellers Ltd. (England), and **Mr. A. F. Burke**, managing director, appointed deputy chairman of de Havilland Aircraft Co. Ltd.

Raymond E. Lee elected president, chief executive officer and a director of Tel-Autograph Corp., Los Angeles, Calif. Mr. Lee succeeds **Louis R. Kurtin**, resigned.

David L. Grimes, president, Narmco, Inc., San Diego, Calif.

Edward J. Doherty, assistant to the president (in charge of public relations-advertising), Vertol Aircraft Corp., Morton, Pa.

P. G. Smith, assistant to the president, Roylyn Inc., Glendale, Calif.

John J. Burke, vice president-engineering, Hallamore Electronics Co., a division of Siegler Corp., Anaheim, Calif.

A. L. Coulson, vice president-sales, Ford Instrument Co., division of Sperry Rand Corp., Long Island City, N. Y.

Thomas E. Rounds, vice president, Barden Corp., Danbury, Conn.

John B. Cowen, executive assistant to the vice president-manufacturing, Aerojet-General Corp., Azusa, Calif.

Honors and Elections

R. C. Oertel, manager of aviation sales for Esso Standard Oil Company, has been elected president of the National Pilots Association.

The **Engineering College Research Council** of the American Society for Engineering Education has announced plans for the Curtis W. McGraw Research Award, established in memory of the late Curtis W. McGraw, former president of McGraw-Hill Publishing Company. The award, sponsored by the McGraw-Hill Book Company, will include a $1,000 prize and will be given annually beginning in June 1957.

Captain E. V. Rickenbacker, board chairman of Eastern Air Lines, received the National Business Aircraft Association's Merit Award for 1956 for his contributions in the development of air transportation.

Gen. Otis O. Benwon, Jr., Commandant of the Air Force School of Aviation Medicine, has been notified of his promotion from brigadier general to major general by the President, making Gen. Benson one of only four major generals in the Air Force Medical service.

Changes

James Everington, industrial relations manager, Lockheed Aircraft Service, Inc., Ontario, Calif. Mr. Evrington succeeds James D. Hodgson, now in the industrial relations organization, Lockheed Aircraft Corp., Burbank, Calif.

Roger V. Rowe, district sales manager (Lima, Peru), Pan American-Grace Airways.

Harvey F. Ludwig, administrative assistant to the executive vice president, Hycon Aerial Surveys, Inc., Pasadena, Calif.

INDUSTRY OBSERVER

► Experimental prototypes of the Douglas Thor intermediate-range ballastic missile and the Convair Atlas intercontinental ballastic missile have arrived at the USAF Missile Test Center, Patrick AFB, Fla., for preliminary testing.

► **Six prototypes of Republic's F-105 Thunderchief are now flying. The aircraft, with thin, short sweptback wings and long cylindrical fuselage, has jet intakes in the wing roots. Flying tail is set low on aft fuselage; the underside of tail has ventral fin for lateral stability.**

► Navy's new Sidewinder air-to-air missile reportedly has such pinpoint accuracy that it can knock flares off the wingtips of an F6F drone without destroying enough of the wing to prevent recovery of the airplane. Sidewinder, which uses simple infra-red guidance system, is being produced by Philco and by General Electric's Light Military Electronic Equipment Dept.

► **Alouette, five-place, gas-turbine-powered helicopter manufactured by France's Sud-Est Aviation, will tour the U. S. late this winter. Republic Aviation Corp., interested in the Alouette as well as in Sud-Est's Caravelle jet transport, will help the French team with the demonstration tour. Republic may build the Alouette here if the tour produces enough interest.**

► Part of Army's effort to move away from dependence upon the Air Force is a move to eliminate fixed-wing planes as launching platforms for target drones in anti-aircraft missile practice. Possible solution, now confined to products of Radioplane Co., a Northrop subsidiary, is to launch the RP-70 aerial target from the larger RP-77 turboprop drone. Both units would be recoverable by parachute. Navy also is interested in the idea as a possibility for providing high-altitude targets for its Sidewinder missile.

► **Navy's air-dropped atomic anti-submarine weapon has been designated Lulu. The weapon has a lethal underwater range measured in miles. World War II depth charges had a 25 ft. lethal radius and had to explode within 12 ft. of its target to split a submarine's pressure hull. Lulu is assembled by the Sandia Corp., Albuquerque, N. M.**

► Bell's turbine-powered YH-40 Army utility helicopter has begun flight tests at the company's Fort Worth, Tex., division.

► **France's Ouest Aviation firm has finished work on a supersonic wind tunnel with a Mach range of from .7 through 1.65.**

► Doman Helicopters Inc., although not included among Army contractors named to conduct a design study on a flying crane, will offer a proposed configuration as a dark-horse candidate. Doman concept features two anti-torque rotors. Pilot will fly sideways to gain full visibility.

► **Navy recently re-examined the question of 25-ft. ceilings for aircraft carrier hangar decks, first installed in USS Forrestal, in hopes of returning to lower ceilings, but decided any cut in height would impose too severe design and strength problems on aircraft tails. A3D already has folding tail for use on carriers.**

► Army's anti-aircraft missiles Nike A and Nike B have been rechristened. They are now known as Nike Ajax and Nike Hercules.

► **Swiss government plans to buy two or three Sud Est Alouette II helicopters. Order follows recent evaluation tests between Alouette and Bristol Sycamore. Portuguese air force has signed a contract for three Alouettes.**

► Doman Helicopters Inc. claims Army suitability test for its YH-31 shows substantial gains in maintainability. Only a little more than one hour of ground work was required for each hour of flight. There is a strong possibility that the French government will order 50 of these aircraft.

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Creating quite a stir in flight circles

Those in the know are saluting the exciting new handmaiden of the skies. The F-27 is the most advanced, the most *needed* aircraft in transport service. Airline proven twin Rolls-Royce propjets power the F-27 in vibrationless, air conditioned and pressurized flight with speeds up to 280 mph, distances up to 2250 miles. For short and medium range performance it is in a class all by itself.

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Address inquiries to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine and Airplane Corporation, Hagerstown 15, Md.

Washington Roundup

Wilson's Successor?

While USAF Secretary Donald Quarles remains an odds-on favorite to succeed Charles E. Wilson as Secretary of Defense, there is increasing talk within the Pentagon of another candidate: Army Secretary Wilber M. Brucker.

Brucker enthusiasts point out that he has done a remarkable job at rebuilding Army morale since taking over the near-debacle left behind by his predecessor. Top Army spokesmen have recovered from earlier defeatism and are using the positive approach to argue the Army's case, with emphasis upon technological capability.

An experienced politician and former governor of Michigan, Brucker has a talent for spreading praise where it will do the most good and marshaling his forces for an effective front. His friends say that these qualities, badly needed in the Army when he took charge, would be equally refreshing in the top Defense post. Possibly more important would be Brucker's ability to say the right thing at the right time, not the wrong thing at the wrong time.

Senate Probe Delayed

Senate hearings on a suspected "leak" of information concerning the Civil Aeronautics Board's award of a New York-Miami route to Northeast Airlines probably won't get underway for at least another month. The difficulty is in getting members of the Permanent Investigating Subcommittee back to Washington to attend sessions. After the election, the senators want vacation time.

Meanwhile, the subcommittee staff and the Federal Bureau of Investigation are continuing their independent investigations of the case. Trading of Northeast stock jumped from approximately 400 shares on Aug. 2 to over 14,000 shares the morning of Aug. 3, immediately after the CAB secretly voted the carrier its new route.

The grand jury now hearing evidence on the case is not expected to return any indictments. It is understood that the main objective of convening the jury was to require some reluctant witnesses to give testimony.

Army Fights Back

Highly significant action by the Assn. of the U. S. Army at its second meeting was a shift in leadership from military to civilian members. Back of the shift is the Assn.'s determination to get the Army's story before the public and encourage debate and understanding of military policy problems. AUSA found this impossible with military leadership that cannot openly fight an administration policy of keeping facts from the public.

Lt. Gen. Walter L. Weible was retired as president and succeeded by John Slezak, former Under Secretary of the Army. Told that the public is not getting more than 20% of the information it needs to make intelligent decisions, the Assn. now can be expected to steer close to the Air Force Assn. pattern. Even Gen. Willard G. Wyman, Continental Army Commander, lauded the skepticism of the press and public and gave the association an assignment of reporting to the people. The doctrine is accepted in Army and USAF circles as contrary to Defense Department and administration policy.

The Assn.'s membership will grow to 50,000 by 1957, and new by-laws will encourage corporations to become sustaining members. The new, aggressive approach of the two-year-old organization won sanction from Army Secretary Wilber M. Brucker, who said new civilian leadership will lead to "better public understanding" of the Army's role. One of the first efforts to create this kind of understanding probably will be release of what contemplated cuts in Army's size will mean to its military program.

House Report Blasts CAB

Latest in a series of congressional blasts at the Civil Aeronautics Board has come from a House Small Business Subcommittee. The House group, headed by Rep. Joe L. Evins (D.-Tenn.), issued a report attacking the Board for "sheltering" scheduled airlines from competition and failing to reduce fares. The report was the result of a study of regulatory agencies made by the subcommittee in the last session of Congress.

The Evins report said that the Board had protected the "vested interests in the airline industry—the grandfather carriers" from fresh competition that could have driven fare levels downward. "Certainly, if entry to the industry is to be restricted, thereby insulating the industry from the forces of the market, the rates should be controlled," the report said.

Jet Fuel Purchases

In six years, jet fuel purchases by the Defense Department have developed from zero to a $337 million-a-year-business.

From less than 3.5 million barrels in Fiscal 1950, Defense Department purchases of jet fuel skyrocketed to over 82.4 million barrels in Fiscal 1956. With the military build-up, defense purchases of aviation gas also mounted during this period: from 22.8 million barrels in Fiscal 1950 to 44.3 million in Fiscal 1956. While the purchases of aviation gas doubled, the purchases of jet fuels multiplied by almost 25-fold.

Irregulars' Status Cloudy

The Civil Aeronautics Board has abandoned the idea of carrying the Large Irregular Case to the Supreme Court and is asking the Court of Appeals to stay its mandate in the case until Dec. 28 while the Board makes up its mind as to what further action it should take. Status of the present operating authority granted supplemental air carriers a year ago has been in the air since July when the Court of Appeals found that the CAB had failed to present sufficient evidence to support use of its exemption powers in granting the interim authority.

The CAB, the Air Coach Transport Assn. and the Independent Military Air Transport Assn. all asked the Court of Appeals to stay its decision pending appeals to the Supreme Court. Now the Board has given up the idea of a Supreme Court appeal, leaving the two carrier groups to decide whether they want to appeal the decision by themselves.

The Board wants a two-month stay to allow time to decide whether it should hold public hearings or take other action in the dispute. A key factor in the decision will be the fact that two men of the three-man majority that voted for the controversial supplemental air carrier operating authority have since been replaced.

—Washington staff

USAF Reveals New X-2 Crash Details

High-speed pitching caused pilot to eject capsule; blackout prevented final steps to safety.

A number of new details on the loss of the Bell X-2 rocket research plane and the death of USAF Capt. Milburn G. Apt (AW Oct. 1, p. 34) have been revealed by the Air Force at Edwards AFB, Calif., and at the Pentagon. Among them:

• **X-2 pitched and rolled violently** shortly after burnout of its rocket fuel—probably in a high-speed turn which Capt. Apt executed to head back towards the dry lake landing bed at Edwards. Apt "was thrown violently about the cockpit." He reached for the handle to eject the pilot's capsule from the X-2 after dropping out of control for 30,000 ft. to an altitude of 45,000 ft.

• **Capt. Apt's death apparently** occurred on impact of the capsule with the ground. He recovered consciousness too near the ground to take the last steps necessary to free himself—stepping from the capsule and opening his parachute.

Chronology of Crash

From the information available, this story emerges:

Apt made his drop from the B-50 and went into his power run.

Capt. Iven C. Kincheloe, Jr., flying a low chase position in an F-86 while another pilot flew higher up and a third flew a photographic plane, said to Apt via radio:

"You're going good . . . you got her . . . suck up her nose . . . pull it back . . . that a boy . . . keeps her coming back . . . you got her . . . back some more."

Towards the end of fuel burning time—which is roughly 140 sec.—Apt said calmly by radio:

"She's cutting in and out . . . She's cut out . . . I'm turning."

Kincheloe asked: "Are you reading?" The reply from Apt was unintelligible. The tape of the conversation was sent to the Federal Bureau of Investigation for help in deciphering Apt's response, but nothing could be made of it.

The Air Force said Apt "probably" began the turn "some five or six seconds after exhausting his fuel." It also said:

"He would still have been traveling at a very high rate of speed, but within the limits the plane had previously flown."

Apparently, the Air Force does not know at precisely what speed Capt. Apt was traveling as the turn began—probably because his violent movement about the cockpit obscured the camera's view of the instrument panel. The camera was located just above and behind his shoulder.

At any rate, the aircraft began to pitch and rolled violently, exerting tremendous G forces on both plane and pilot.

Cockpit Camera Findings

Photographs made by the cockpit camera show that Capt. Apt was thrown violently about the cockpit. They also show him reaching for the handle to eject the capsule. The handle was located on the cockpit floor between his legs.

The camera's speed was one frame per second. The final frames show that Apt was thrown sharply backward as the capsule separated. There is no film record beyond that point because separation cut the camera from its power source.

At the end of his run, Apt was at approximately 70,000 ft. At separation, he already had fallen to approximately 45,000 ft. The air stream would throw the capsule upward and rearward if the plane were in a normal flight attitude.

"There probably was some violent tumbling of the capsule, but this area is fuzzy," Brig. Gen. J. Stanley Holtoner, commander of the Flight Test Center at Edwards said. Tumbling time before a deceleration chute on the capsule opened probably would have been two or three seconds.

Ejection

The capsule dropped at a speed of between 125 and 150 mph. (probably at about 128 mph.) and possibly in a slightly curved path rather than straight down, at least for the first few thousand feet.

Separation shifted the X-2's center of gravity to such an extent that the rocket engines no longer made it extremely tail heavy, and its momentum carried it downward almost in a glide. It landed belly first, and almost all of the instrumentation was recovered. A phototheodolite operator on the ground followed the plane's path to the ground, probably because it was larger than the capsule.

Apt's capsule would have fallen at roughly 188 fps.—some six times faster than he would have dropped in his own parachute. The drop in the capsule would have taken about four minutes.

It is clear that Apt took some of the steps towards survival. His body was found in the capsule, and the canopy was nearby.

At first, investigators assumed that impact jarred the canopy loose. Examination showed, however, that locks on the canopy and on the cockpit were undamaged, indicating that Apt had reached upward and pulled the canopy release himself.

Apt also had unfastened his seat belt. It is a type, the Air Force said, that could not be unfastened by impact.

Jettisoning the canopy and opening the belt left Apt exposed down to the shoulders. Standing up would have freed him from the capsule.

"Evidently Capt. Apt, dazed or hurt by the violent bucking, may have been further incapacitated or blacked out by the tumbling of the capsule, which subjected him to a strong negative G forces," Air Force said.

"Still in the capsule, he managed to jettison its canopy and unfasten his seat belt but not in time to then get out of the capsule before it hit the ground."

The coupling of inertial forces that shook Capt. Apt's plane so violently is a phenomenon of high-speed flight. Gen. Holtoner said in describing Apt's background:

"Capt. Apt flew the F-100 in inertial coupling tests. He knew more about this particular subject than anyone in the Air Force."

Preparing for Flight

In planning for the flight, no speed limit was imposed "nor was there any direction to make any specific speed or to depart from the known areas or en-

Material for this story on the reasons behind the crash of the Bell X-2 rocket plane and the death of its pilot, Capt. Milburn G. Apt, was gathered and written by Aviation Week Senior Engineering Editor Irving Stone at Edwards AFB, Calif., and Military Editor Evert Clark in Washington.

X-1A Accident

A comprehensive report of the accident Aug. 8, 1955, in which X-2's predecessor, X-1A, was destroyed begins on page 111 this issue. Fortunately, the X-1A pilot, NACA employe Joseph A. Walker, was rescued in heroic action by companions in the B-29 mother ship bomb bay before the X-1A was jettisoned.

velope of knowledge," according to Gen. Holtoner.

"The necessity for imposing maximum speed limits was discussed," Gen. Holtoner said. "Rather than have the pilot watch the Mach meter or air speed, it was determined that it would be more important to have him concentrate on the attitude, normal acceleration and minimum use of control."

The Air Force previously has announced that Capt. Apt reached a speed "never before attained by man." The figure generally quoted is more than 2,100 mph., although the Air Force has never confirmed it.

The Air Force has attributed this record speed to two things:

• **Apt achieved the optimum** "aiming" attitude very quickly after drop—"on a thousand to one chance," Gen. Holtoner said. "He did what no other pilot has been able to do so far on his first crack at it."

• **Apt obtained approximately** six seconds more burning time from the rocket engine than any pilot of the X-2 has received before.

Asked if Capt. Apt's flight plan could have been laid out "in such a way that this (speed) would not have happened," Gen. Holtoner said he was sure it could have.

What Part Speed Played

Asked if it would not "have been sensible to have him fly at half throttle," Gen. Holtoner said:

"The optimum flight path is something we shoot for on every flight. . . . Attitude is the key factor in this optimum plan. In Capt. Apt's case, he came as close to the optimum on his first flight as we have ever seen. It was one of those chances which we did not allow for.

"I think that every supervisory guy from me down has criticized himself because if we had told this boy to stop at a specific speed this wouldn't have happened. . . . The most difficult part of earlier flights has been learning the techniques for establishing and maintaining the desired flight path. It was anticipated that a number of flights would be required before a new pilot could satisfactorily accomplish this precise maneuver."

Background to Flight

Asked if there were any specific relation between the fact that Apt flew faster than anyone else and the fact that he had the accident, Gen. Holtoner said:

"No, speed did not cause the accident. The natural conclusion to draw is that this is what caused the accident, but it didn't."

Originally, the X-2 was to have been turned over to the National Advisory Committee for Aeronautics last month for heat and control and stability research. In September, however, a few days before Capt. Apt's flight, the Air Force received permission and funds to extend its flying time with the X-2. It had asked for this permission for several reasons:

• **Air Force had the development** responsibility for the X-2, and the job of demonstrating that it would meet design specifications. After Lt. Col. Frank K. (Pete) Everest's record flight at 1,900 mph. last July (AW Aug. 6, p. 454), he felt the X-2 could reach an even higher speed.

Therefore, at the time of Capt. Apt's first, and final, flight, the Air Force did not feel the speed-altitude envelope had been fully explored.

• **It was known last February** that Col. Everest was to be assigned elsewhere. Maj. Charles Yeager already had been taken off the rocket project. So Capt. Iven C. Kincheloe, Jr., who set a altitude record of 126,000 ft. (AW Sept. 24, p. 29) in the X-2, and Capt. Apt were assigned to the program—Kincheloe for altitude and Apt for speed. Both had aeronautical engineering degrees, graduate test pilot school experience and "a number of basic, important test projects behind them," Gen. Holtoner said.

• **Air Force also wanted** to train Kincheloe and Apt because it "felt we should maintain a nucleus of rocket experience so we can take on new projects as they develop."

Scheduling of the two new pilots was "thoroughly coordinated with the contractor, the Air Force, NACA and Curtiss-Wright (manufacturer of the engine)," Gen. Holtoner said.

• **In addition to training pilots** and finishing up its work with the X-2, the Air Force was to have checked out one NACA pilot and turned the plane over by next spring. "The interim period," Gen. Holtoner said, "was going to be used for NACA instrumentation, possible changes in control systems to allow for additional controllability in the future—basic changes actually in the control system of the plane. The point is: there was no pressure on Capt. Apt. The time had been extended almost indefinitely. There was no pressure or limit. If there had been, he wouldn't have flown the airplane.

Horner: USAF Must Devote More Funds to R&D, Less to Production

Baltimore—To maintain technological superiority, the USAF must devote more of its budget to research and development, diverting funds from production by exercising "ruthless selectivity" in determining which weapon systems go into production and USAF inventory.

This opinion was voiced by Richard E. Horner, Acting Assistant Secretary of the Air Force for R&D, speaking here at the East Coast Conference on Aeronautical and Navigational Electronics.

This ruthless selectivity "will result in disappointment to many competing members of our industrial society," Horner said. "However, through these policies we are determined to get the maximum amount of defense for every taxpayer's dollar," he added.

Duplication: Pro & Con

If USAF could save 15% of its present production expenditures by such selectivity, it could increase its R&D effort by 50%, Horner said.

Horner reported that the USAF is studying a new approach to formulating its R&D budget which may result in identifying research and development as the entire process from the birth of an idea in basic research through the testing of the prototype weapon systems.

The several different U.S. weapon systems for delivering a strategic nuclear attack, as well as duplicate systems for air defense, logistic support and tactical support, make the enemy's job more difficult and give us a flexibility needed to meet a variety of possible combat situations, Horner said.

R&D Inexpensive

However, this situation has several serious disadvantages, Horner indicated. In small quantity production, per unit costs are higher and the operation of several different systems is expensive. Even more important, the variety of weapon systems increases training requirements, logistic support problems, and complicates base structure, Horner said. These problems are further aggravated by the need for world-wide development of our combat forces.

"Research and development are fundamentally inexpensive, especially when compared to the costs of the military machine, such as procurement of materiel or the operation of military units," Horner said. "It only becomes prohibitively expensive when we try to exploit all possible lines of development and carry all of them to the ultimate of production for the inventory.

"This leads to the conclusion that selectivity is necessary. The question of how and where it is applied is perhaps the most difficult and controlling problem in the management of the research

and development program. Decisions resulting from such judgment become more difficult, and more important, as the projects progress through the research, development and procurement phases," Horner said.

Greater Selectivity

By exercising far less selectivity at the pure and applied research end of the scale, and far more at the production end, "we can assure ourselves of having explored the maximum number of technical possibilities and of an ever increasing quality in our weapons," Horner said.

The difficult job of selectivity is not made easier by pressures from firms who are convinced that their particular development is the best answer to military requirements, Horner indicated. Emphasizing that he did not mean to impugn the integrity of military contractors, Horner pointed out however that this situation has resulted in the sponsoring of fewer development projects in order to avoid the selectivity decision at a time when it is most difficult to make in the face of industrial, and sometimes political, pressures.

Funds spent for R&D which do not result in mass production "are far from wasted," Horner emphasized. "It is virtually impossible to apply scientific manpower without development of new knowledge which is certain to be useful in an eventual application," he added.

Diversion of USAF funds from production to R&D would appear to require more engineers and scientists per dollar spent. AVIATION WEEK therefore asked Horner, following his speech, whether he believed the required manpower could be found to support an increased R&D effort. Horner said he now believes that there is a sizable untapped supply of scientific manpower not now engaged in military R&D. (This is a view that might be contested in some quarters.)

Profit Margins

Because most military contractors view their unprofitable R&D efforts solely as a means to a profitable production end, AVIATION WEEK asked Horner whether the USAF might allow greater profit margins on R&D. He indicated that such a move was under consideration.

Low profits on military R&D are a sore point with many military contractors. The head of one major avionics firm told AVIATION WEEK: "The government will allow more profit on a company's investment in drill presses than on its investment in PhDs."

Wilson Confirms Contracts for Chemically-Fueled WS-110A

Confirmation of contracts for the chemically-fueled WS-110A supersonic bomber weapon system was made by Defense Secretary Charles E. Wilson on a nationwide television program.

North American Aviation, Inc. and Boeing Airplane Co. have received contracts for the bombers. Presumably the specifications will call for supersonic dash speeds on the order of Mach 2 over the target.

Some sources speculate that the performance will be obtained using conventional turbojet engines burning standard fuels for the cruise and switching to afterburning with chemical fuels for the dash to the target and the breakaway home.

Favored choice among current chemical fuels is pentaborane, a liquid hydride of the light metal boron. Diborane and decaborane as well as the hydrides of lithium have been investigated, but activity in the chemical field now seems to single out pentaborane.

Basic reason for the choice of an exotic fuel is its high heat content per pound. Standard aviation fuels – gasoline, kerosene and JP-4 have a heat value range from 18,500 Btu./lb. to 18,900 Btu./lb. Pentaborane has a heat content of 29,127 Btu./lb., better than 50% improvement over the hydrocarbons.

Pentaborane is lighter than gasoline; it weighs about 38 lb./cu. ft. compared to gasoline's 42 and kerosene's 51.2 lb./cu. ft. Where weight of fuel is not a major consideration in the mission of an airplane, such as in a short-range fighter, the denser fuel can show some advantages in available energy per cubic foot. Kerosene, for example, has a heat value of 946,000 Btu./cu. ft. compared to 790,000 for gasoline.

But in a long-range airplane, where fuel weight is a major design factor, the lighter density and higher heat of combustion of pentaborane pays off.

Actually, the heat value per cubic foot of pentaborane is 1,109,193 Btu./cu. ft.

Thus a specific volume of tankage occupied by pentaborane will be lighter in weight than gasoline and have more energy available per cubic foot of tank space or per gallon than kerosene.

USAF Gets Sidewinder

Washington—USAF will use the Navy-developed Sidewinder air-to-air guided missile on day fighters of the Air Defense Command and Tactical Air Command. Designated GAR-8 by the Air Force, the Sidewinder will augment, but not replace, the Hughes Falcon.

As contracting agent for the weapon, the Navy has awarded two new contracts for Sidewinder, combining its own requirements with those of USAF. According to the Bureau of Ordnance, the joint purchase has resulted in bringing the cost below original estimates.

The new contracts for production of guidance and control units were awarded to Philco Corp. ($14 million) and General Electric Co. ($17 million).

The Navy already has equipped attack squadrons of the 6th and 7th fleets with Sidewinder (AW Oct. 22, p. 33).

USAF Restudies Work On Bomber Defense

Air Force has issued stop orders on two current contracts for bomber-defense missile systems.

Re-evaluation of the two BDM systems, plus a third proposal rejected earlier, is being done for the Air Council, according to informed sources.

Unofficial industry reaction is that the stop orders were prompted by reconsideration of the chemically fueled WS-110A bomber delivery system.

Two industrial teams were affected. Prime contract for one BDM system was held by Republic Aviation Corp., with Westinghouse as the sub-contractor.

Other system prime contractor was General Electric Co. working with McDonnell Aircraft Corp. as subcontractor.

Third system reported to be in the running again was proposed by the American-Bosch-Arma Corp. in earlier competition with the Republic and GE systems. The Arma proposal was not bought at the time the others were.

Industry sources have different interpretations of the USAF stop order. One firm believes it is a complete cancellation of the project; another feels that it is possible the project may be resumed.

But meantime all design work has stopped.

Both contracts covered work through Phase Two in parallel development programs, comparable to the backup procedures instituted earlier for the intercontinental ballistic missile.

Basic decision on resuming the BDM projects has been referred to the Air Council, which has not yet made a final selection or rejection.

Hawker Plans New 1,800 mph. Fighter

London—Hawker Siddeley Group Ltd. will develop a new 1,800 mph. fighter with its own funds despite the Ministry of Supply's initial lack of interest in the project. First flights are scheduled to be made within 18 months.

While withholding official government sanction, Reginald Maulding, Minister of Supply, made the first announcement of the project to the House of Commons last week. It was later confirmed by Neville Spriggs, managing director of Hawker. The fighter has been designated the Hurricane after Hawker's best-known aircraft of World War II.

The Ministry of Supply reportedly had not stated a requirement for the fighter and turned down the new Hurricane idea when it was offered. The company went ahead, however, at its Kingston-on-Thames factory, encouraged by wide dissatisfaction over the government's attitude towards aviation development.

Air Commodore F. R. Banks, a British authority on jets, already has declared that the Roval Air Force has slipped since World War II to a point where it now stands fourth among world powers in the quality of its aircraft (AW Oct. 29, p. 21).

The Hawker group is now credited with circumventing the Ministry's slow procurement procedure in an effort to match such achievements as the U. S. Lockheed F-104.

New British Transport

London—De Havilland will design a new jet transport with the speed and range of currently-planned U. S. jet carriers for introduction over British Overseas Airways Corp. routes by 1962. The U. S. transports are scheduled to begin service in 1959 and 1960.

The aircraft firm said it is "urgently discussing" technical details of the aircraft with BOAC, which already plans to buy 15 Boeing 707s (AW Oct. 29, p. 39). The transport has been designated the D. H. 118.

A de Havilland spokesman said the aircraft will be capable of operating over both high and low-density routes and from existing airports. The D. H. 118, de Havilland said, "should have speed and range capabilities comparable to the large American jets but would be somewhat smaller in size."

De Havilland said BOAC will place an order as soon as final specifications have been decided upon.

WHAT appears to be a painting of Convair's B-58 Hustler (above) is actually a photograph of the prototype airplane, heavily retouched by Defense Dept. Many of the B-58 detail design features have been obscured or eliminated, by intent or through unfamiliarity with the airplane. Among the changes: eliminating the nose inlet spikes on the podded General Electric J79 turbojets; eliminating the cambered leading edge on the wing; changing cross-section shape of the engine nacelles; changing the wedge-shaped section of the engine pylon; addition of a large shadow area to hide details of the inboard nacelles. An unretouched photograph of the Hustler has already appeared in Aviation Week (Sept. 10, p. 34).

Hustler May Make First Flight This Week

Fort Worth, Texas—Convair's B-58 supersonic bomber may make its first flight sometime this week.

The delta-wing Hustler began taxi tests, final phase of its ground-test program, early last week. At the time, August C. Esenwein, Convair vice president and manager of the Fort Worth plant, said the first flight of the new bomber would be made "probably within 10 days."

The test crew includes B. A. Erickson, chief test pilot and manager of flight for the Fort Worth plant; J. D. McEachern, flight observer, and C. P. Harrison, flight test engineer.

The B-58, which will be capable of carrying a variety of weapon packs beneath its fuselage, is powered by four podded General Electric J79 turbojet engines.

Its triangular wing has elevons in the trailing edge, which combine the control functions of conventional ailerons and elevators. A swept-back vertical stabilizer and rudder give directional control and stability.

Bell Reorganizes Niagara-Frontier

Buffalo, N. Y.—Bell Aircraft Corp.'s Niagara Frontier Division, dating from World War II, has been reorganized into two new operating groups in a move to decentralize control over the firm's diversified interests.

A new Aircraft Division and a Weapon Systems Division will replace the former Buffalo-Niagara Falls operation.

Bell's Texas Division is scheduled to assume a wholly-owned subsidiary status when its incorporation as the Bell Helicopter Corp. is finalized on Jan. 1, 1957.

The new Buffalo divisions will have responsibility for sales, design, production, procurement and allied functions of their product lines. Leston Faneuf, new Bell president, announced that vice-president Julius J. Domonkos will be general manager of the Aircraft Division and vice president Roy J. Sandstrom general manager of the Weapon Systems Division.

The Aircraft Division will design and produce Bell airplanes and control the company's subcontracting of aircraft components for other prime contractors.

It will have two subdivisions, production and engineering.

Robert J. Woods, designer of the Bell X-1 rocket research plane, the Bell X-5 and the P-39, has been named director of engineering and sales of the Aircraft Division.

Terence M. Nolan will serve as works manager of the division; Ralph W. Varrial will serve as factory services manager.

The Weapon Systems Division will have four units: avionics, rockets, guided missiles and research.

The Bell reorganization was planned before the death of Lawrence D. Bell (AW Oct. 29, p. 37), former president and founder of the company. Bell retired as president shortly before his death.

Pilots Warned After Freak F-11F Crash

By Evert Clark

Washington—Pilots of supersonic U.S. fighter aircraft have been warned not to hold course after firing their machine guns as a result of an unusual accident in which a Grumman F-11F-1 Tiger overtook several of its own projectiles.

Neither combat tactics nor aircraft design will be altered as a result of the accident, but Navy's Bureau of Aeronautics and Bureau of Ordnance feel that such an incident could happen again, given the right circumstances.

First to Overtake

Aircraft have run into their own projectiles before when the projectiles were "tumbling"—either because of a faulty gun or faulty ammunition. But Navy spokesmen said they believe the Tiger is the only aircraft to overtake its own projectiles when they were following a normal trajectory.

The Tiger collided with at least two, and probably three or possibly four, rounds of 20-mm. target practice ammunition during a contractor firing demonstration off Long Island, N. Y., last Sept. 21.

Grumman pilot Tom Attridge was flying at 13,000 ft. He put the Tiger into a shallow dive at ½G. He fired two four-second bursts from his four 20-mm. cannons. As his speed and the downward angle of his dive increased and drag slowed the flight of the projectiles, the Tiger ran into its own fire.

Muzzle velocity of the projectiles was 3,200 fps. Velocity of the plane in feet-per-second at the time the projectiles struck was about 1,290.

Rate of fire was 1,000 rounds per min. per gun, which gave Attridge about 266 rounds per burst.

Twelve seconds after the firing of the first burst, as the plane reached 880 mph. and 7,000 ft., Attridge's windshield was shattered.

Next he noticed a dent in the upper edge of his starboard air intake duct—a mark that indicated something had hit the edge of the duct and glanced off.

Attridge assumed he had run into a flock of birds. As he turned back towards the Grumman field at Peconic River near Calverton, Long Island, his engine failed. Still unaware that he had run into his own bullets, Attridge tried two air starts.

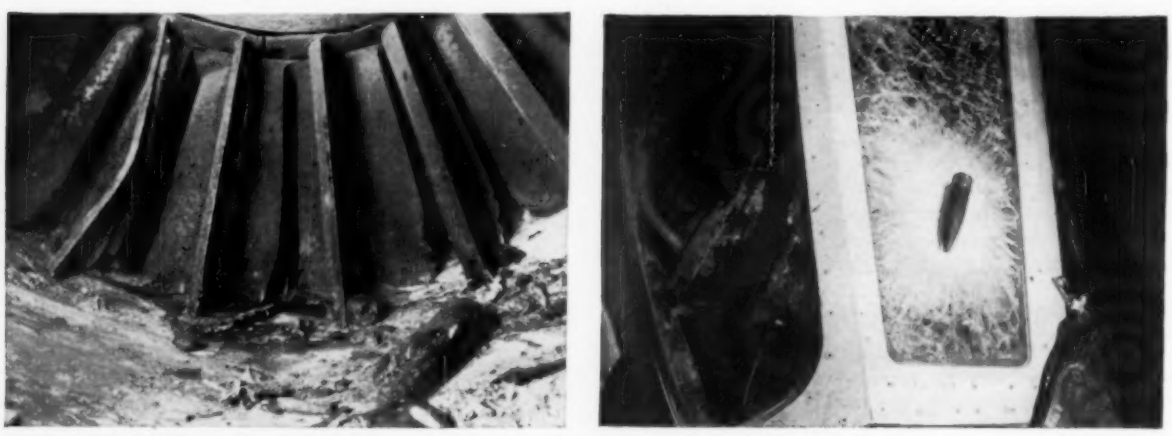
When both failed, he made an emergency landing in trees on Long Island, tearing off the Tiger's wings and injuring himself seriously.

What Investigation Showed

Investigation showed that:

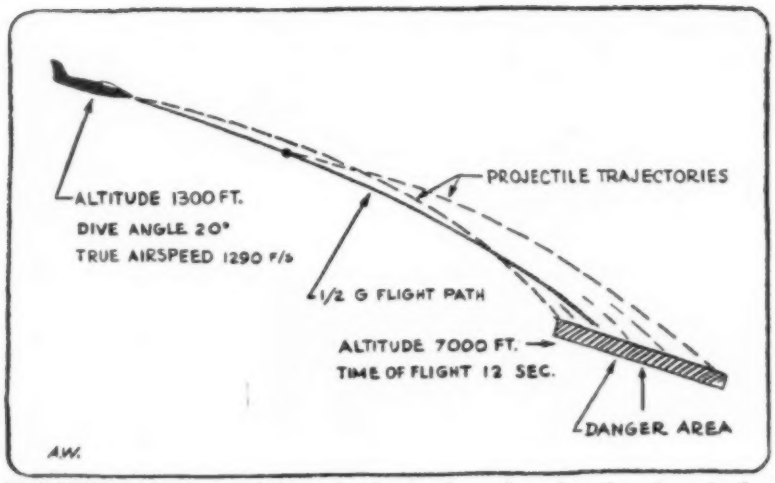
- **One projectile struck** the nose of the plane on the port side, just aft of the probe. The indentation showed that the projectile was aft end first when the plane struck it.

  Spin marks in the dent made it clear that the projectile was spinning in normal flight.
- **A second projectile** struck the windshield. Examination revealed a shallow indentation in the center of the shattered area, into which a 20-mm. target round fit perfectly.



DEBRIS, including spent 20-mm. slug, in engine intake is shown (left) with twisted inlet guide vanes. Bullet placed on windshield shows approximately where it hit. Luckily, slugs apparently were about spent when F-11F overtook them.

TEAR in F11F nose cone is just aft of flight refueling probe. Bullet placed at right shows how plane overtook slug from rear.



CONCEPTION of apparent flight angle showing how plane flew through projectiles.

• **Badly-battered projectile** was found in the jet engine's compressor area. Chipped edges on the compression blades and marks on the projectile made it clear that the bullet had been bounced back and forth many times, pushed in by the airflow and thrown back by each blade.

• **20-mm. projectile** fired aft end first from an air gun at a Tiger nose section made the same type of indentation that the 20-mm. bullet made in the nose of the Tiger which Attridge flew.

The projectile in the engine could have been either the one which hit the nose or the one which hit the windshield. And if Attridge was correct about the dent in his starboard intake, it could even have been a third or fourth projectile. The crash damaged the intake too severely for examination to reveal anything.

Navy computations of the dispersal of fire on this particular flight indicate that Attridge could have hit at least three of his own bullets.

Tumbling No Factor

Although "tumbling" of the projectiles can not be completely eliminated as a possibility, the angle at which the projectiles and the aircraft met and the spin marks left on the nose have convinced Navy's ballistic experts that tumbling was not a factor in the accident.

Basically, the problem Attridge encountered is that relative increase in aircraft speeds has been so much greater than the relative increase in muzzle velocities—although the conditions contributing to this particular flight were unusual for a combat aircraft. In this regard, the Navy points out that:

• **In combat,** a supersonic fighter always would operate at much higher altitudes and in maneuvers that would rule out its diving under its own fire.

• **Supersonic fighters** probably would not make strafing runs at the speed which Attridge was flying, and the curve would be a 1G-plus curve, rather than the less-than-1G curve Attridge flew.

Bureau of Ordnance ballistics experts have informally computed the combinations of factors that would put an aircraft in a danger area from its own fire. Lower altitudes—where drag on a projectile is higher—and a smaller difference between muzzle velocity and speed of the plane increase the danger time and size of the danger area.

The Navy said it does not consider this a major problem in any way. Word was sent to the fleet and to all contractors who might be affected primarily as a precautionary measure. The Air Force also was advised of Navy's findings in the Attridge incident.

XV-3 Crashes in Test; Program Will Continue

Ft. Worth, Texas—Army's XV-3 convertiplane program will be continued at the Bell Aircraft plant here despite the loss of the first aircraft in an unexplained crash on Oct. 25.

Bell pilot Richard Stansbury, who was flying the convertiplane in helicopter configuration at the time of the crash, was seriously injured. A joint Air Force-Navy team is investigating the accident.

Company officials said Stansbury took off from the plant two or three minutes before the accident.

The XV-3 evidently failed to maintain altitude. It was not indicated whether Stansbury was trying to tilt the twin roto-propellers at the time.

The XV-3 has been under test without incident since April, 1955. It already had performed a 15-degree conversion.

Second P6M Modified To Insure Full Safety

Washington—The Martin Co. and the Navy, still unsure of the exact cause of the XP6M-1 crash 11 months ago, have made a number of minor modifications in the second SeaMaster—all of them aimed in the direction of super caution.

Failure of the first SeaMaster's control system allowed the horizontal tail to turn full up suddenly, throwing the jet seaplane into such a severe downward turn that the engines ripped out and went straight ahead.

The heavy negative force of 9G—imposed upon the wings as the aircraft suddenly lost speed and the wings turned almost perpendicular to the airstream—wrapped the wings around the fuselage. Navy spokesmen said the wings clapped together beneath the fuselage, and the wing tips then flapped back outwards with a positive G force. Bits of wing were found imbedded in the fuselage and parts of each wing also were found imbedded in the other, Navy said.

The specific reason for the control system's failure has not been determined, although an intensive investigation has narrowed it down to six possibilities:

• **Minor explosion** in the center wing stub, which might have damaged control cables, hydraulic lines or electrical circuits.

• **Broken or snagged** control cable.

• **Loss of pilot fell-force** in the longitudinal control system.

• **Loss of one** of two duplicate hydraulic systems.

• **Elimination of hydraulic** power from the stabilizer actuator.

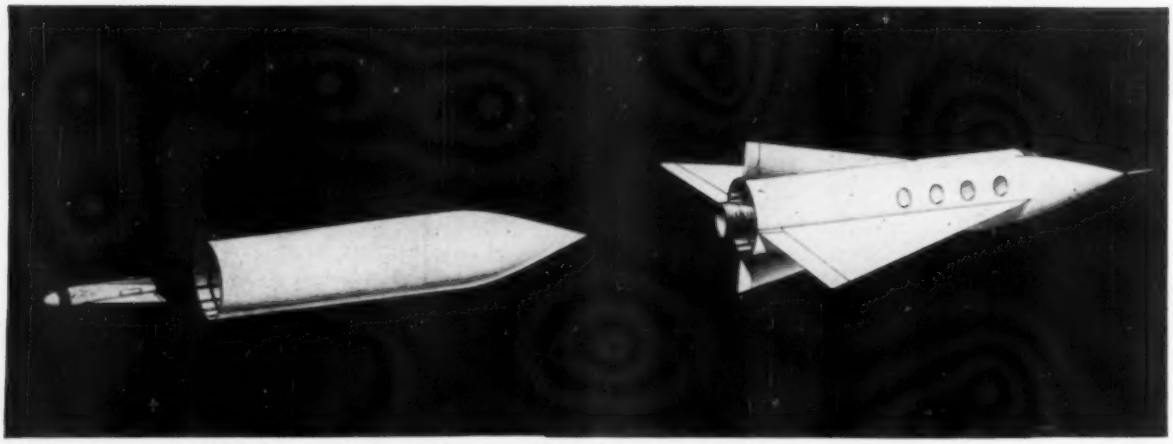
• **Pilot error** in handling the controls.

Martin asked the senior design engineers concerned with each area of suspicion to assume that their area was the cause of the accident, and asked each group to see what changes they would make if they were re-designing systems and parts of systems for increased safety.

None of the suggested changes were major, and none were considered to be essential to safe flight of the second plane, but, with Navy's Bureau of Aeronautics concurring, they were made anyway.

Wiring, relays and electrical equipment in areas where vapor might exist have been vapor-proofed; vinyl fibre leads have been added where control surfaces might snag, and hinge moments have been restudied on the instrumented second plane. None of the tests with second SeaMaster have given a clue thus far to the cause of the first crash.

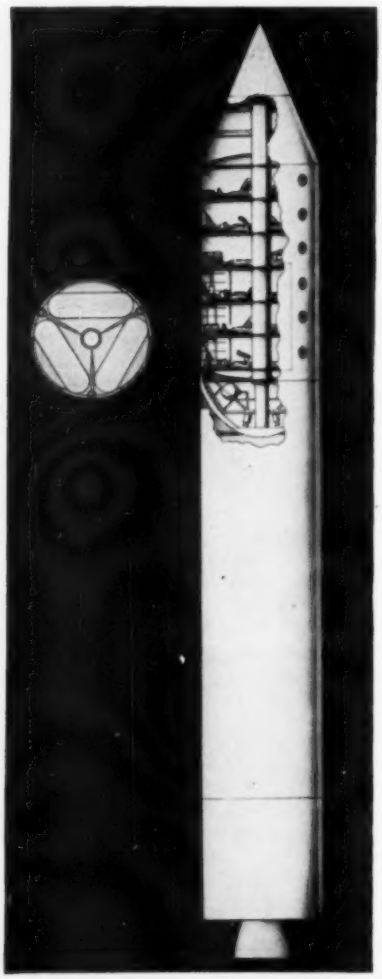
The second plane has been flying since early last May.



FREIGHT-CARRYING MISSILE approaches manned space satellite station in this artist conception.

Army Expands Scope, Challenges USAF

By Claude Witze



TROOP CARRYING missile suggested by U. S. Army drawing. Cutaway shows accommodations for crew and troops.

Washington—Tacticians and weapon development experts of the U. S. Army are convinced that an Air Force will be outmoded in the foreseeable future.

In an aggressive effort to revive the Army's prestige and get its story before the public on the eve of an expected Pentagon showdown over service roles and missions, new ground soldier concepts and capabilities will be widely promoted.

What Army Says

Promulgated in speeches by high-ranking officers at the second annual meeting of the Assn. of the U. S. Army, these concepts include:

• **Missiles already are reducing** Army's requirement for close combat support from USAF's Tactical Air Command. As a weapon delivery system, the airplane will have the shortest life of any vehicle or propulsion device in the history of warfare.

• **Army says it is the most experienced,** most advanced and most expert designer and operator of guided missiles. It lacks only the men, money and material to strike out into new capabilities justified by the present state of the art. Army competence and leadership in missiles and rocket power are "clearly established." Despite the shortages, these soon will result in greater "offensive capabilities."

• **Army is the one service** fully equipped and competent to provide all the supporting elements necessary to missile warfare. These include reconnaissance of missile sites, transport of missiles to the sites, camouflage and defense against enemy ground and air attack. In addition, the Army is able to shift the launching site in any kind of terrain, support dispersed units and provide necessary engineering skills vital to "ultimate effectiveness."

• **Army will give new emphasis** to protecting its logistic bases from enemy detection and attack, as well as increased Army mobility. Aerial transport, nuclear energy and solid fuel will get more attention in the program to increase mobility.

New Depth and Mobility

Back of all this discussion of the "Futurarmy" at a three-day meeting attended by 1,000 delegates, lies the introduction of atomic weapons to the battlefield. According to Lt. Gen. C. D. Eddleman, deputy chief of staff for military operations, the advent of these weapons will add vastly to the depth of a combat zone. Presumably, it could cover an entire continent, and the Futurarmy will need, in addition to its atomic firepower, improved mobility and communications.

Adding emphasis to this concept was an unscheduled address by Dr. Edward Teller, University of California physicist and advisor to the Atomic Energy Commission. Teller declared that it is not necessary to use nuclear weapons against civilian populations. They can, he said, be concentrated on armed forces.

"There are those who believe that, in the atomic age, the only effective service will be the Air Force," he told the association. "With proper planning, the other services can make similarly good use of nuclear explosives."

Basic Fighting Units

Teller then drew a picture of an Army in which the basic fighting units are battle groups of a few hundred men each. Equipped with the best possible transportation and communication, these men would be armed with "a few

dozen nuclear weapons with assorted delivery systems."

These battle groups, in Dr. Teller's concept, would be able to appear at any place in the world within two days. He compared them to the "knife of a surgeon" rather than the "axe of an executioner."

Technician Need

The main problem for the Army in preparing for this kind of war—in which air power will not figure—was described by Dr. Teller as one of personnel. Soldiers would have to be trained technicians capable of keeping their equipment in repair.

They would be professionals of the highest standards.

Most outspoken participants in the association meeting were: Gen. Maxwell D. Taylor, Army chief of staff; Maj. Gen. John B. Medaris, commander of the ballistic missile agency at Redstone Arsenal; Lt. Gen. James M. Gavin, chief of Army research and development; Gen. Willard G. Wyman, Continental Army Command, and Dr. Wernher von Braun, chief of Army's ballistic missile development.

Von Braun described in detail the operation of a space platform that could be manned and utilized to control a separate launching device for guided missiles.

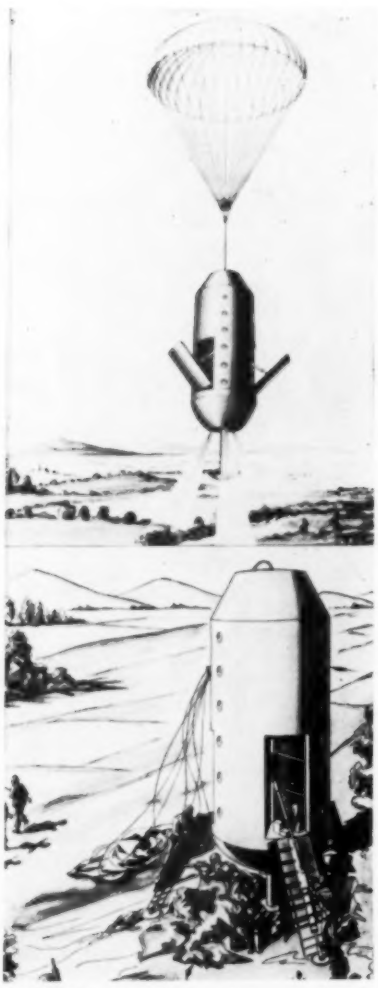
Space Platform

He said techniques exist to make it possible that within four or five years an unmanned station could orbit the globe to transmit information. The manned space ship he described as the next "inevitable planning goal."

Gen. Medaris indicated that the Army's Redstone missile has surpassed his hopes in performance. Reported to have hit a target 3,000 mi. away (AW Oct. 4, p. 25), Redstone's security status prevents disclosure of less than 10% of its achievements, the General said. He added:

"We have challenged the Redstone system and Dr. von Braun's associates with a wide variety of objectives above and beyond those already achieved by the missile as a single weapon system. Every such challenge has been met in superlative fashion, successfully and on time."

He held out even greater hopes for the new Army intermediate-range ballistic missile, the Jupiter, and reported that the development project is on schedule.



DESCENT of troop-carrying missile is slowed by rockets and parachute. Infantry then goes into action.

Argentine to Build T-34 Under Beech License

Buenos Aires—First licensing and technical assistance agreement between a U. S. aircraft manufacturer and the Argentine government since World War II will be signed in New York City this month, according to Michael G. Neuberger, manager of Beech Aircraft Corp.'s Export Division.

The agreement, covering the Beech T-34 Mentor two-place trainer, is valued at approximately $4 million.

Informed sources close to the South American government state that approximately 90 T-34s will be purchased over a three-year period, with an initial lot of 15 trainers being flown to Argentina in December.

An additional 10 aircraft will be delivered next March, disassembled and 90% complete.

The contract calls for most of the planes to be assembled in the Cordoba plant of Industrias Aeronauticas y Mecanicas del Estado (IAME), a government enterprise, with technical aid from Beech.

The agreement also provides for Argentine manufacture of the complete airframe, if desired.

CAA Need

The Civil Aeronautics Administration has an urgent requirement for a horizontal radar display capable of providing a 50 in. diameter display area with a minimum brightness of 10 ft.-lamberts in highlights with ample contrast. If possible, device should be able to display numbers/characters alongside radar targets and should provide storage type display so that aircraft trails can be observed.

Interested companies should contact Mr. David Crippen, Technical Development Center, Civil Aeronautics Administration, P.O. Box 5767, Indianapolis 21, Ind.

Private Pilots Will Not Need Instruments

St. Louis—Acting Civil Aeronautics Administrator James Pyle assured private pilots last week that instrument ratings would not be compulsory when the three-year federal airways plan is fully implemented.

In an address before the National Aviation Trades Association here, Pyle said, "about the only thing a pilot will need to get around freely is a two way radio."

He added: "Perhaps some inexpensive radar reflector will be necessary on fabric aircraft."

Pyle suggested, however, that high-altitude private aircraft may ultimately be required to carry radar beacon transponders, distance measuring equipment and other devices.

"The man who can afford a pressurized aircraft won't worry about this, and the man in a light plane won't have to," he told the group.

In describing the three-year airways plan, Pyle said all IFR flights above 25,000 ft. will be placed under airways control this spring and "by the end of 1957, the control floor should be down to 15,000 ft.

He said plans call for bringing omnirange airways down to 700 ft. from 1,100 ft.

He called this a decided advantage to private pilots who normally fly at lower altitudes.

News Digest

Convair Division of General Dynamics Corp. received a USAF contract to modify a number of test versions of the F-102A all-weather fighter to operational tactical versions. First of the aircraft, which eventually will be assigned to the Air Defense Command,

French Trident 2s

Ten Trident 2s have been ordered by French Air Ministry as a pre-production batch. Prototype Trident 2 (above) is powered by a pair of Dassault-built Armstrong Siddeley Viper turbojets of 1,650 lb. thrust each, and a pair of SEPR liquid-propellant rockets of undisclosed thrust. Plane has made more than 100 flights; ceiling is limited by the pilots vulnerability at extreme altitude. Ten following planes will have Turbomeca Gabizo wingtip jets rated at about 2,400 lb. thrust each. Trident 2 changes include a lengthened and redesigned landing gear, a single-piece windshield-canopy and a two-chamber rocket powerplant instead of the three-chamber unit of the Trident 1. Fuselage appears lengthened, but it may be an illusion caused by gear height and nose boom change. Plane is lighter and faster than the Trident 1; wingspan is about 23 ft., weight is about five tons. Earlier model made sustained supersonic flights, was designed for Mach 1.6. Ouest Aviation, builder, says it has "amazing stability" in high-supersonic speed maneuvers.

will begin arriving at Convair-Fort Worth from USAF test centers sometime next month.

Holland will expand Schiphol Airport to handle KLM jet airliner traffic. The 8-year, D47-million program will include construction of four 10,000-ft. runways and a central traffic area.

Italy sent 50 jets over her major cities to find out whether aerial reconnaissance as proposed in President Eisenhower's "open skies" plan could detect military activity. Traveling at a speed of 550 mph. at 18,000 feet, planes took photos pinpointing individual military vehicles.

Iranian oil consortium ordered six de Havilland Doves for service in the Middle East. Delivery of eight-seat Series 5 Doves will begin by December of this year.

Kaiser Aluminum & Chemical Corp. acquired Hokin Aluminum Co. extrusion plant at Dolton, Ill. Plant's capacity of 18 million pounds of extruded aluminum and tubing will speed Kaiser's mid-west expansion program by two years.

Beech Aircraft Corp. dropped the trade name "Badger" for its new Model 95 executive plane to prevent confusion with Russian bomber of the same name.

Convair's 35,000 employes have nearly doubled their own national safety record by working more than 17 million man-hours (87) days without a lost-time accident.

Real Aerovias airlines of South America has acquired 85% of the voting stock of Nacional Airlines. With a total of 109 planes, Real-Aerovias-Nacional now operates the largest fleet in South America. On order are 6 Convair 440s and 5 Douglas DC-6Bs.

Boeing YC-97J Turbofreighter recently made a round trip flight from Dover, Del. to Burtonwood, England in 24 hours 5 minutes carrying 24,000 pounds of cargo.

Westland Aircraft Ltd., England, is ready to begin construction of its "Westminister" prototypes, a 5-ton or 40-passenger gas-turbine helicopter of simplified "crane" type.

Vickers-Armstrong Ltd. has set up military aircraft office headed by Jeffrey Quill. Function is to study military aircraft requirements in England and abroad.

Iraq will construct three major airports at a cost of $42 million to relieve increasingly heavy traffic at the Bagdad and Basrash fields.

Lockheed Missile Systems Division has begun moving into the first of three new plants in the San Francisco Bay area which will add 240,000 sq. ft. of floor space by July.

Correction

A headline in AVIATION WEEK mistakenly said that Therm-O-Lab Corp., North Hollywood, Calif., was being sued for patent infringement by Electrofilm, Inc., Los Angeles (AW July 2, p. 32).

Electrofilm filed suit in Superior Court of California charging Therm-O-Lab with appropriating the rights to a heating element. Electrofilm based its claim on a contract with a former employe of Therm-O-Lab.

A. R. Booker, president of Therm-O-Lab, states that the case is not a patent infringement case. He further says Therm-O-Lab's ceramic heating element was invented by Bernard Kwate who assigned the pending patent to Therm-O-Lab.

PROTECTION FOR YOU

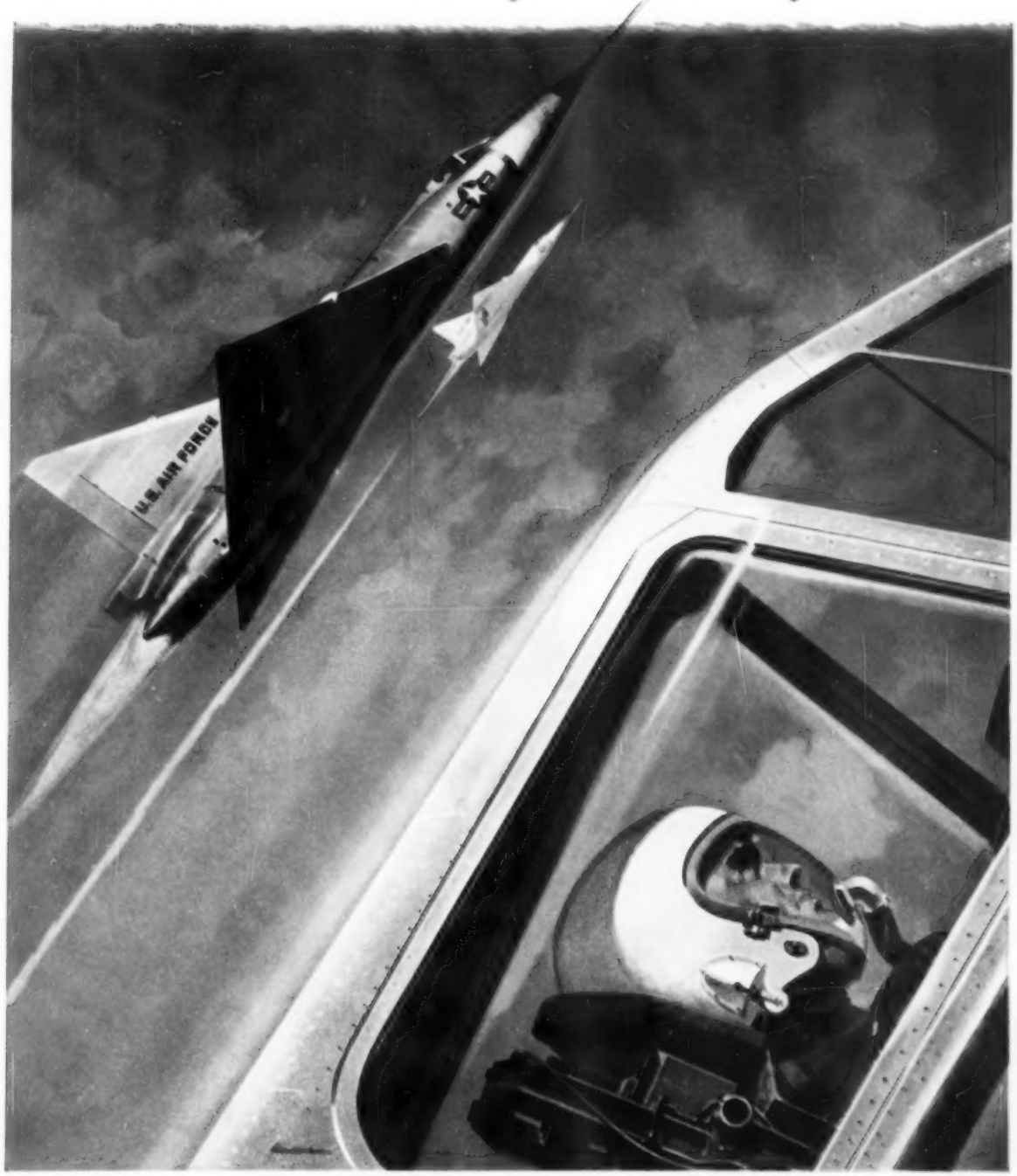
"Beyond the Wild Blue Yonder"

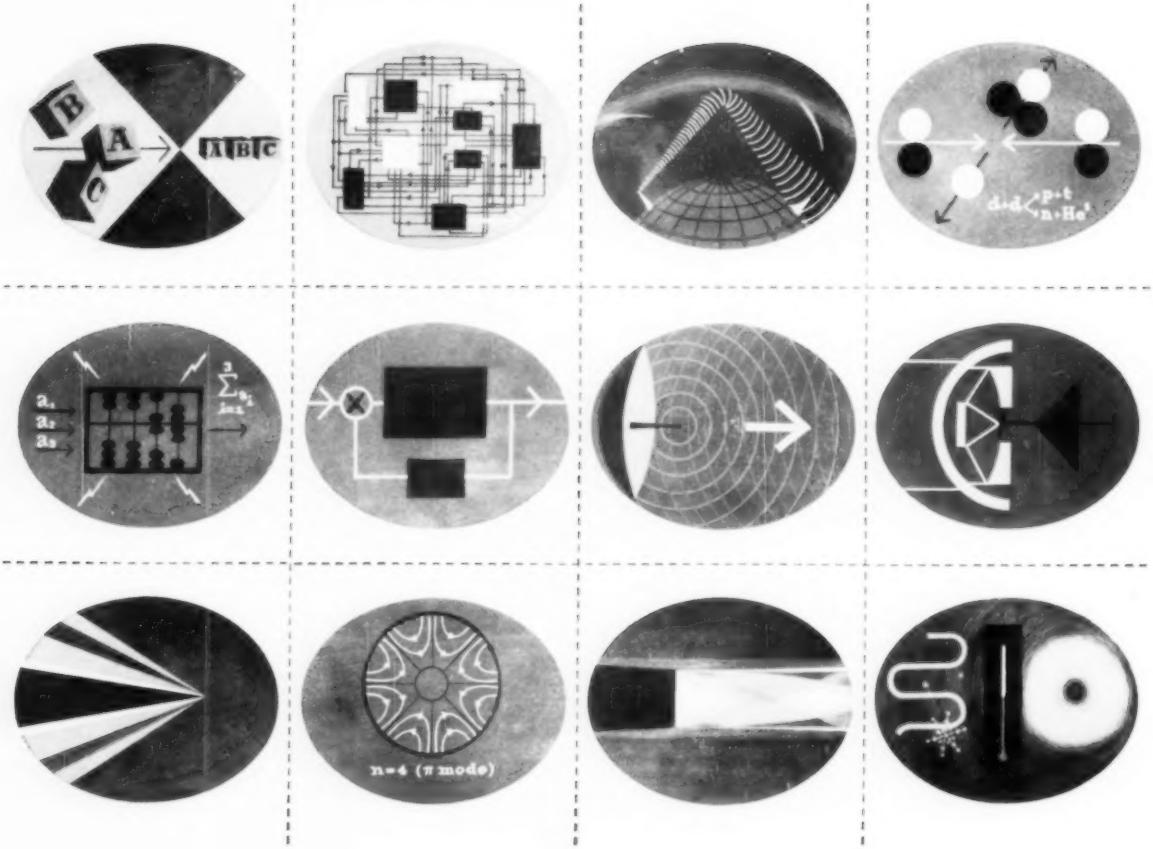
For your protection, Convair's delta-wing F-102A Interceptor is now flying with the U.S.A.F. Air Defense Command. It reaches far into the stratosphere in a supersonic hurry – pinpointing an invader in any kind of weather, at any time of day or night!

Through *Engineering to the Nth power,* Convair's F-102A has conquered time and distance, extending freedom's protective barrier – far *beyond the wild blue yonder!*

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION





Variety of Technical Fields

These illustrations are symbolic of some of the scientific and engineering fields of endeavor which are essential ingredients in the broad range of technical programs that are in progress at The Ramo-Wooldridge Corporation. Illustrated are: Information Theory, Systems Analysis, Communications, Nuclear Physics, Electronic Computers, Servomechanisms, Electromagnetic Propagation, Infrared, Aerodynamics, Microwaves, Propulsion, and Thermodynamics.

The requirement for technical competence in a wide variety of fields is a significant characteristic of systems engineering work. At R-W this requirement is particularly important because of our emphasis on the development of systems having a high content of scientific and engineering newness.

Our current military contracts support a number of advanced programs in the fields of modern communications, digital computing and data processing, fire control and navigation systems, instrumentation and test equipment. In the guided missile field, Ramo-Wooldridge has technical direction and systems engineering responsibility for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. Our commercial contracts are in the fields of operations research, automation, and data processing. All of this work is strengthened by a supporting program of basic electronic and aeronautical research.

Scientists and engineers whose training and experience are in these or related fields are invited to explore the openings at The Ramo-Wooldridge Corporation.

The Ramo-Wooldridge Corporation

5730 ARBOR VITAE STREET · LOS ANGELES 45, CALIFORNIA

A 2½ TON TRUCK (above) is extracted from Lockheed C-130 Hercules, and (bottom right) flies through the air with six cargo parachutes billowing overhead during tests made by USAF and Army at Pope Air Force Base, N. C. A Marine anti-tank weapon weighing 22,235 lb. (bottom left) is loaded into C-130 for drop exercise. Plane is capable of carrying 20 tons of equipment, 92 combat-equipped troops, or 70 litter patients. C-130 becomes operational for USAF in December.

C-130 Undergoes Rigid Combat Tests

Marietta, Ga.—Air Force's new prop-jet transport Lockheed C-130, demonstrated its ability to deliver troops and supplies by parachute during simulated combat condition tests at Pope Air Force Base, N. C.

The airplane will become operational in December.

The 3245th Bombardment Test Group from Eglin Air Force Base conducted the tests in cooperation with Continental Army Command Board Five of Ft. Bragg, N. C.

Eighty-six missions were flown, dropping a total of 160 tons of supplies. These included self-propelled weapons, jeeps, guns, food, medical supplies, trucks and various types of road building equipment.

During one six-day period the C-130 was put through 25 missions. Four missions were run daily, five on the sixth day. When the plane landed from one mission it was quickly checked for maintenance while the loading crew placed cargo.

The plane was tested for "turn-arounds"—changing the craft from personnel carrying to heavy equipment cargo-carrying.

These were accomplished in as short a time as 20 min. The C-130 can carry 20 tons of equipment, or airlift 92 combat-equipped troops, or serve as a 70-litter hospital ship.

On one flight the C-130 dropped a 22,235-lb. Marine weapon on its first pass over the drop zone, and on a second pass dropped personnel to man it.

One malfunction during the exercises resulted in a belly landing. The landing gear stuck in the closed position. Capt. Russell Dobyns, the pilot, brought the craft in for a smooth touchdown which damaged only the skin undersurface of the fuselage. Frame wrinkling or distortion did not occur. The following day the gear was worked down, locked, and the plane was flown to Marietta for study and analysis.

Earlier this year, the C-130 set what is believe to be a record for dropping heavy cargo. At El Centro, Calif., the plane dropped a single platform loaded with 27,000 lb. of iron.

Lockheed said the shakedown flights at Pope Air Force Base showed up some "operational bugs," but generally they were successful.

CAA Details Results of Collision Tests

General acceptance of proximity-warning devices needed to ease threat of mid-air collisions.

By L. L. Doty

Indianapolis—Civil Aeronautics Administration's Technical Development Center last week reported the first results of mid-air collision tests it has conducted over the last four years. Its finding: Only general use of proximity warning devices will substantially halt the steadily-increasing threat of such accidents.

Tests consisted of a series of DC-3 flights operated from the Technical Development Center's headquarters here by airline pilots on pre-arranged collision courses. The flight tests were supplemented by a detailed analysis of 50 typical mid-air collisions that occurred between 1949 and 1955. Although the study has not yet been completed, these conclusions have been reached:

- **Greatest danger of collision** lies in one aircraft overtaking another. The TWA-United Air Lines accident over Grand Canyon on June 30 is presumed to have been caused by one aircraft overtaking the other.
- **Warning to a pilot** that potential collision danger exists is not sufficient information for prevention of a collision. Also increased pilot vigilance provides no real security against most collision accidents.
- **Relative bearing** of an existing collision threat must be known to the pilot to give him enough time to see the other aircraft and execute an avoidance maneuver. This time-distance element is the critical factor in approaching a solution to the mid-air collision danger.

Proximity Indicator Benefits

The Technical Development Center has concluded that general use of a proximity warning indicator with a mile range operable to an altitude of 500 ft. would have reduced past mid-air collisions by more than 50%. Collins Radio Co.'s proximity warning system recently adopted by the airlines through the Air Transport Assn. has a two-mile range with an 800-ft. radius of detection (AW Sept. 24, p. 37).

A single range of detection, however, is not adequate for all aircraft, according to TDC instrument and accessories specialists who are conducting the tests.

They recommend, for example, a three-range device for high-speed jet aircraft.

The shortest range would be used in airport traffic control, where slower speeds prevail. Medium-range would be used in lower altitude flights, with high-range detection being confined to high-altitude cruising operations.

The time-distance factor becomes a major element in collision prevention of jet aircraft because of the high-closure rates. Tests demonstrated that, in the sudden pull-up of a jet aircraft traveling at 400 knots per hour, the airplane mushed for approximately one mile before responding to the controls.

At the present, the CAA is conducting joint tests with the Air Force to measure side-slip distances of jet aircraft in order to determine the exact range requirements of warning devices. This much is known, however, jets will not react to radical maneuvers in time to prevent a collision unless a minimum of two miles warning is given the pilot.

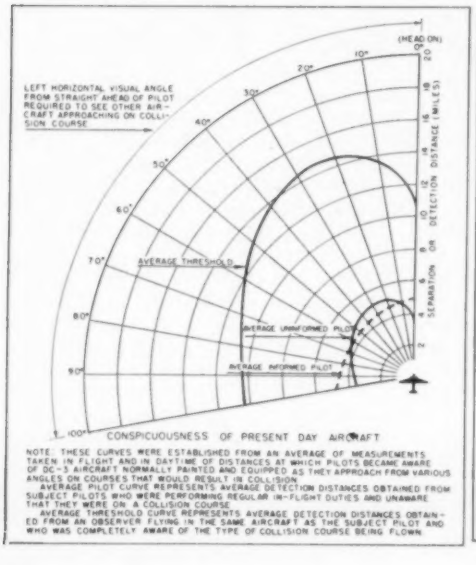
High-range devices cannot be used on slower aircraft according to the TDC, since pilots of these planes would be plagued by needless false alarms in high-density traffic areas. The Collins device may solve this problem since its system, which goes into production in September 1958, can be adjusted in range from a maximum of two miles to a minimum of 800-ft.

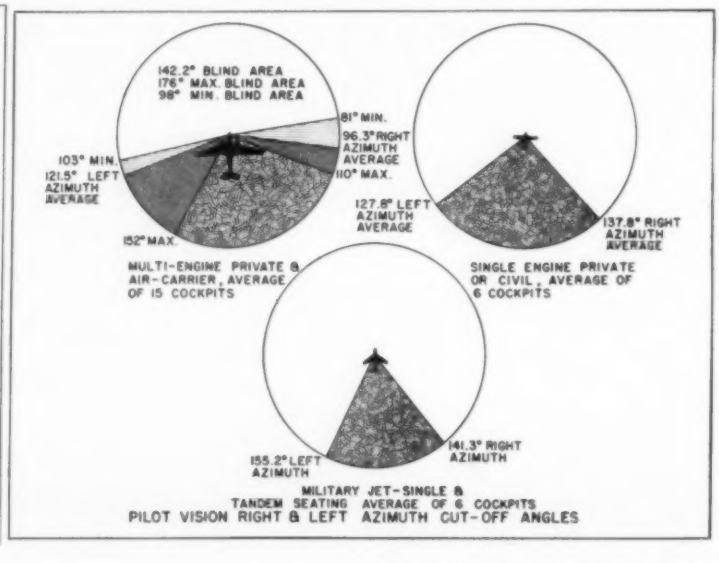
The Technical Development Center has operated a total of 128 collision flight tests.

Collision Flight Tests

In some instances, pilots were not warned that a collision danger was imminent; others were told that they are on a collision course but were given no bearing information on the threatening aircraft.

Whether or not pilots were informed of potential collisions made little difference in time of detection. Average distance at which both groups spotted a DC-3 flying on various convergence


(HEAD ON)
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
LEFT HORIZONTAL VISUAL ANGLE FROM STRAIGHT AHEAD OF PILOT REQUIRED TO SEE OTHER AIRCRAFT APPROACHING ON COLLISION COURSE
DETECTION DISTANCE (MILES)
SEPARATION ON
AVERAGE THRESHOLD
AVERAGE UNINFORMED PILOT
AVERAGE INFORMED PILOT
100%
CONSPICUOUSNESS OF PRESENT DAY AIRCRAFT
NOTE: THESE CURVES WERE ESTABLISHED FROM AN AVERAGE OF MEASUREMENTS TAKEN IN FLIGHT AND IN DAYTIME OF DISTANCES AT WHICH PILOTS BECAME AWARE OF DC-3 AIRCRAFT NORMALLY PAINTED AND EQUIPPED AS THEY APPROACH FROM VARIOUS ANGLES ON COURSES THAT WOULD RESULT IN COLLISION.
AVERAGE PILOT CURVE REPRESENTS AVERAGE DETECTION DISTANCES OBTAINED FROM SUBJECT PILOTS WHO WERE PERFORMING REGULAR IN-FLIGHT DUTIES AND UNAWARE THAT THEY WERE ON A COLLISION COURSE.
AVERAGE THRESHOLD CURVE REPRESENTS AVERAGE DETECTION DISTANCES OBTAINED FROM AN OBSERVER FLYING IN THE SAME AIRCRAFT AS THE SUBJECT PILOT AND WHO WAS COMPLETELY AWARE OF THE TYPE OF COLLISION COURSE BEING FLOWN.


142.2° BLIND AREA
176° MAX. BLIND AREA
98° MIN. BLIND AREA
81° MIN.
96.3° RIGHT AZIMUTH AVERAGE
110° MAX.
103° MIN.
121.5° LEFT AZIMUTH AVERAGE
152° MAX.
MULTI-ENGINE PRIVATE & AIR-CARRIER, AVERAGE OF 15 COCKPITS
127.8° LEFT AZIMUTH AVERAGE
137.8° RIGHT AZIMUTH AVERAGE
SINGLE ENGINE PRIVATE OR CIVIL, AVERAGE OF 6 COCKPITS
155.2° LEFT AZIMUTH
141.3° RIGHT AZIMUTH
MILITARY JET-SINGLE & TANDEM SEATING AVERAGE OF 6 COCKPITS
PILOT VISION RIGHT & LEFT AZIMUTH CUT-OFF ANGLES

courses was between two and five miles, with informed pilots having the edge over uninformed pilots in head-on collision threats.

There were nine actual near-misses recorded in the tests. Surprisingly, seven of the near-collisions occurred with informed pilots at the controls. Observers flying with pilots in the test runs, who knew the exact relative bearing of the DC-3, sighted the potential collision threat at distances of between 10 and 15 miles.

Blind areas of aircraft are directly responsible for failure to observe overtaking aircraft.

A study of 27 cockpits in all types of aircraft showed that multi-engine private and airline aircraft are more limited in pilot azimuth visibility then either single engine private aircraft or military jets.

Forward Visibility

Azimuth range of forward visibility in transports averaged from minimums of 103 degrees left of center and 81 degrees on the right to a maximum of 152 degrees on the left and 110 degrees on the right.

This compares with a 155-degree left azimuth and 141-degree right azimuth on single and tandem seating military jets.

Vertical cut-off angles of multi-engine aircraft were shown to range from a maximum of 16 degrees below azimuth to zero degrees at azimuth. Above the azimuth line, visibility cut-off was as high as 45 degrees and as low as 10 degrees. Forward visibility on other types of aircraft was found to be similarly limited.

The Technical Development Center has made flight path and pilot-eye-movement studies to establish minimum cockpit requirements and has developed a binocular cockpit camera that photographs a "pilot's eye view" of visibility range from the cockpit during various critical maneuvers.

A Fairchild Flight Analyzer Camera that records from the ground the attitude of landing and takeoff aircraft in each phase of the maneuver is used to obtain an accurate check on performance and flight path.

Where Collisions Occur

Although the results of these photo tests have not been adopted as CAA regulation, they are being incorporated as standard design in such newer aircraft as the DC-8, Boeing 707 and Lockheed Electra. The Martin 4-0-4 was the first aircraft to be designed with these standards which include thinner window frames and wider windshield areas.

The Office of the Chief of Army Transportation is sponsoring visibility tests on helicopters and Army reconnaissance aircraft to establish new windshield standards for such aircraft in field operations.

TDC tests indicate that 88% of the accidents studied were caused by one aircraft overtaking another. Only 8% were straight head-on collisions.

Most of the collisions occurred in the vicinity of airports with 24% taking place over and within airport boundary limits.

High Density Lights

The Technical Development Center is also considering the use of high density lights as one means of improving daytime conspicuity of aircraft. A 600-watt, 500,000-candlepower lamp with a 30 degree sweep to the left and right has been installed in the nose of a DC-3 for test purposes. The light was found to be visible in bright daylight at a distance of 14 miles, although the aircraft was obscured from view beyond 11 miles.

Fluorescent paint also is being studied as another means of improving the conspicuousness of aircraft. An Ercoupe has been painted with Day-Glo blaze orange paint manufactured by Switzer Brothers, of Cleveland.

Laboratory tests are underway to determine the best methods of framing an outline against such various natural backgrounds such as clear sky, clouds, haze and ground.

Soviet Tu-104 Sets Moscow-Delhi Record

Soviet Tu-104 set a Moscow-Delhi speed record recently by making the 3,200 mi. journey in six hours, including a fuel stop at Tashkent, Soviet Uzbekistan.

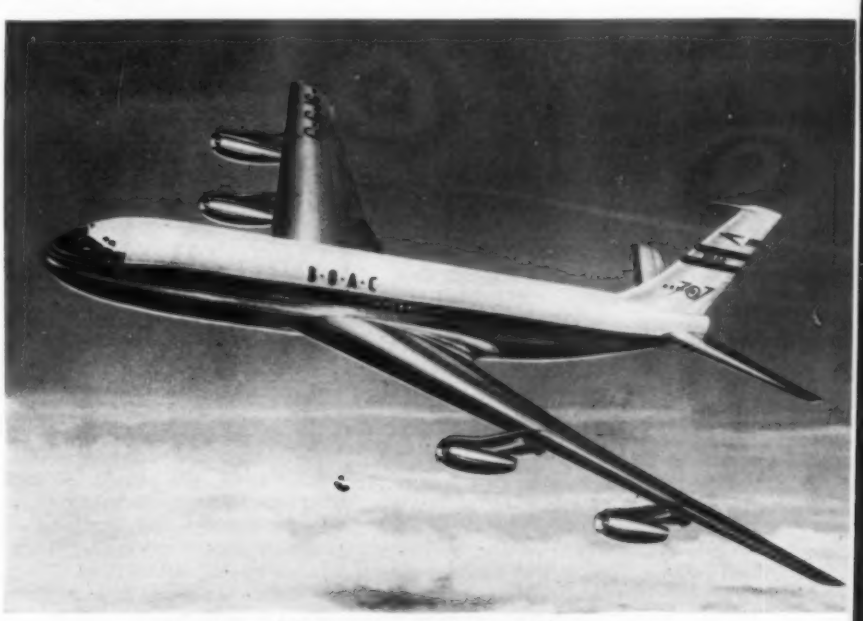
The flight, which terminated at Rangoon, Burma, was apparently a barnstorming tour intended as part of Russia's campaign to build commercial air ties with countries of the far eastern neutralist block. Only passengers were members of the Soviet Civil Aviation Bureau, Russian technicians and four Indians.

Before continuing the flight to Rangoon the Tu-104 stayed two days in Delhi giving joy rides between Delhi and Agra.

The Moscow-Delhi trip was made at a speed of 600 mph. and an altitude of 35,000 ft. Plane commander Sapelkin reported a 650 mph. ground speed on the two-hour leg from Tashkent because of tailwinds. The aircraft's fuel was kerosene.

The course of the Tu-104 avoided Pakistan territory by crossing the Pamirs and the Himalayas.

The same plane will be used later to carry Soviet athletes to the Olympic Games that are to be held in Melbourne, Australia.



Boeing 707 in BOAC Colors

British Overseas Airways Corp. colors will fly on 15 Boeing 707-420 jet transports which the British government permitted BOAC to order. BOAC plans to use the transport for transatlantic, possibly transpolar and transpacific flights, the latter via the U. S. to Australia. Rolls-Royce Conway engines will power transports, which will have a maximum all-up weight of 295,000 lb. (285,000 lb. at break-ground), maximum landing weight of 195,000 lb. They will carry 107-170 passengers at a cruising speed of 525-575 mph. Maximum cruising height will be 40,000 ft. and maximum still air range 6,500-6,750 mi.

New Braniff, Delta Route Prospects Good

By Glenn Garrison

New York—Braniff Airways and Delta Air Lines, newcomers to the world's largest and perhaps most competitive air travel market, have not found the going easy during their first eight months in the New York-Washington to the south service. Braniff has "turned the profit corner," however, according to Charles E. Beard, the carrier's president. And Delta president C. E. Woolman predicts that this winter's business will produce "satisfactory results" for the current year.

The two southern airlines moved into new Yankee territory last February after receiving new routes from Civil Aeronautics Board in the Southwest-Northeast Service Case, decided last year. Braniff was authorized to fly between Fort Worth-Dallas and New York and Washington via Memphis, Nashville and Chattanooga. Delta got a route between Houston and New York through extension northward from Atlanta, via Charlotte, Washington, Baltimore and Philadelphia, and west from New Orleans to Houston.

Moving into the crowded New York complex—served by every United States trunk air carrier except Western Air Lines—Delta and Braniff found the only available space at Newark Airport, where they set up shop with three daily flights each. Braniff now offers four daily flights to the south—two combination class in the airline's new DC-7C equipment, two first-class flight in DC-6s.

Constellation Coaches

Delta in April tied Philadelphia, Baltimore and Charlotte into the route with Convair flights, has since introduced Constellation coaches, and as of next month will offer eight schedules out of New York, three of them in DC-7 equipment. The flights total 511 seats daily, about double the initial capacity available at New York.

Delta's load factors over the route have not been good so far. While the airline won't say exactly what they are, the system average load factor for the year ending June 30, 1956 was 62.5%, and it's safe to assume the loads between New York and south have averaged considerably less than that.

Big problem for Delta has been relative unfamiliarity of its name to passengers originating in the New York area. Capital Airlines and Eastern Air Lines not only offer greater frequencies on route segments competitive with Delta, but enjoy the advantage of well-established reputations in this part of the country.

It's a problem the airline feels is being licked, however, and Delta points to its successful experience at Chicago, where the airline established service to the south a decade ago. Woolman points to the fact that Delta's sales as well as seats on the New York route have doubled during the eight months of operation.

Failure to win the New York-Florida route which went to Northeast Airlines was a great disappointment to Delta, obviously, but the airline says none of its equipment purchases or other plans were predicated on obtaining the offered routes.

Braniff reports even more encouraging results on its new route. Load factors have improved steadily and the first two weeks of October showed a load factor 25% higher than during March, according to the airline. Seats, meanwhile, increased 94 daily. Total of passengers boarded at New York was 36% higher in September than in March.

Revenues Increased

Beard says revenues increased steadily on the new route until June figures showed a modest net profit. Inauguration Oct. 20 of DC-7C service (AW Oct. 22, p. 41) is expected further to improve Braniff's position in the market. Braniff's biggest competitor on the route is American Airlines.

Both airlines expected round-trip traffic from southern points to account for most of their initial business, but it hasn't worked out that way. Delta reports that almost from the beginning of its new service, 75% of the traffic has originated in New York. Braniff says the proportion of New York-generated traffic has been considerably greater than anticipated.

Delta and Braniff have stressed service in their promotion, pushing the "southern hospitality" angle. Their culinary approach promotion-wise has differed, however, with Delta offering American style steaks to order (tell the reservations clerk rare, medium or well), and Braniff taking the continental view with elaborate silver, and such items as Rock Cornish game hen.

Delta has ordered DC-7B equipment, with first deliveries expected in spring, some of which will go to the New York run. First of seven Convair 440s is now on Delta's system, and seven more are expected by April. The airline's jet equipment on order includes 10 Convair 880s and eight Douglas DC-8s.

Braniff has ordered five 440s, nine Lockheed Electras and five Boeing 707s. Its DC-7C fleet will total seven aircraft, with some of the planes going onto Braniff's international routes next spring.

Both carriers plan to divide their New York operation between Idlewild and Newark airports when facilities are available at the former field. Delta expects the move to take place late next year or in early 1958; Braniff plans to go into Idlewild next spring.

Braniff's maintenance has been handled at Newark by United Air Lines, but Braniff has brought its own crews to the airport to maintain its DC-7s and hopes to have a facility of its own at the airport in the near future.

Controllers Propose New Ways For Jet, Helicopter Integration

Washington—Air traffic controllers last week injected new strength into their recently formed organization and proposed new ways to cope with increasing traffic and integration of jets and helicopters into control patterns.

In its first national convention the 2,000-member Air Traffic Control Assn. re-emphasized its role as a professional association rather than a union. It voted to assist Civil Aeronautics Administration's controller recruiting program and laid out plans to present suggestions for revised standards to the Civil Service Commission.

The group concentrated heavily on current and future air traffic control problems.

While healthy disagreement prevailed during a full-session panel discussion, general conclusions reached were:

- **Visual flight regulations** should be revamped to permit more flexible penetration into approach patterns. Two-way radios should be standard on all aircraft operating in high density areas.
- **Controllers should be granted** discretionary authority to establish or cut-off IFR regardless of weather.
- **Standard flight rules** for helicopter operations should be made available as soon as possible to prevent conflicting control procedures in certain areas.

VFR Minimums

Most controllers opposed a suggested increase of VFR minimums from three to five miles visibility as too stringent a penalty on private pilots. Generally, a variable or sliding-

scale VFR minimum adjustable to local conditions was favored and a restudy of VFR standards along these lines was proposed.

Lack of two-way radio on some aircraft was held responsible for terminal traffic hold-ups in IFR zones. Controllers want control of all aircraft in approach and departure operations in order to provide tightest possible separation. Such a goal, they said, is attainable only with unlimited two-way communications facilities.

Last-Minute Switch

Border-line weather cases in terminal areas calling for a change-over from en route VFR to local IFR operations are posing a serious problem in some areas. Controllers said reluctance of some pilots to make the last-minute switch to IFR causes approach delays. They want authority to establish IFR conditions and require IFR operations whenever safety and efficiency dictate.

They also felt that a pilot's privilege to cancel an IFR flight plan during an approach should be modified to give the controller a voice in such decisions in order to retain aircraft separation control.

Helicopter traffic control problems become evident only as such traffic increases in numbers. Chicago controllers handling about 54 helicopter operations daily, and Los Angeles with 110 operations, reported no unusual traffic problems with this type of aircraft.

But LaGuardia Airport—handling about 175 helicopter operations a day—is encountering ground control traffic problems in moving helicopters in and out on established schedule.

Helicopter Traffic

Chief problem at LaGuardia is conflict of helicopters with taxiing aircraft. Controllers also asked for flight rules governing helicopters, although they urged against unnecessary restrictions in en route patterns. Helicopter separation, they explained, can be more exact and tighter than for fixed wing aircraft.

Controllers foresee no serious problem with jet transports. Several controllers, however, complained that military jets are "consuming air space." Inability to impose speed restrictions on some types of military jets was given as one problem in integrating jets with conventional aircraft.

Jet traffic, the controllers said, does not fit into outbound traffic flows because of high speeds. One controller suggested a "spiral-out" maneuver for outbound jets as a substitute for a tunnel departure.

Acting CAA Administrator James Pyle told the controllers at a luncheon meeting the air route traffic control center space shortage is being studied. "We are looking into the possibilities of putting up our own center buildings, designed along functional lines and easily and inexpensively expandable in width, length and height," he said.

Pyle also told the group that direct pilot-controller communications will be instituted within the current fiscal year. "We have already let contracts totaling over $700,000 for the equipment to solve this plan," he said.

Pyle said the recent decision by the Civil Service Commission on controller standards may not satisfy all but "it does offer real gains."

He said agreement has been reached with CSC to seek better answers to this problem. The new study will begin after Jan. 1.

Edward Curtis, special assistant to President Eisenhower for aviation facilities planning, said his group was "not prepared to say what form" the future airways system should take. He added, however: "The tools we need to do the job are available today or will be in the future. The problem is one of selection rather than invention."

Curtis forecast airline fleets would not increase substantially in number during the next 20 years. "Larger and faster aircraft will generate a tremendous increase in passenger-miles flown and the number of take-offs and landings will increase correspondingly," he said.

Military aircraft will tend to decrease as various types of missiles are introduced and perfected, he said.

During a business session, controllers cited a number of cases in which qualified controllers were being rejected for employment with no reasons given. Discharged military men are being overlooked as a potential source of recruiting, it was charged.

The group also accused CAA of "vindictiveness" in refusing to rehire former CAA controllers at original grade levels.

Airlines Reroute, Cancel Flights As Middle East Conflict Begins

New York—Airports at Cairo and Damascus were closed to civil aircraft and several international carriers had suspended services to Tel Aviv last week as the Egyptian conflict threatened to become a major Middle East war. The airlines were canceling some schedules, rerouting others, and preparing to offer aid in evacuating nationals from the trouble area.

Pan American World Airways planes were standing by in Beirut and Rome for possible evacuation duty, and Trans World Airlines reported aircraft were ready in Athens if needed to take U.S. citizens from points in the Middle East.

El Al Israel said in New York it was continuing to operate its normal schedules as other airlines put Tel Aviv off limits to their planes.

Playing it largely by ear, the airlines were adapting their operations to the omnious and changing situation. Examples:

• **Pan American's** round-the-world flight No. 2 crossed Syria to Karachi before the Syrian government deadline last Tuesday for civil flights over Syria. The return flight was rerouted via Tehran to Istanbul. A special PAA plane was sent to Ankara to pick up a Civil Aeronautics Administration team to certify a new route for the airline's round the world service, via Istanbul to Tehran and Karachi.

Pan American's Flights 64 and 65 will terminate at Beirut instead of flying on to Syria and Iran. The round the world flights will continue on schedule via the new route over Turkey and Iran, according to the airline.

• **TWA will turn** its far eastern flights around at Athens temporarily. It hopes to operate to Bombay and Colombo shortly when an alternate route is worked out and approved.

• **British Overseas Airways** is bypassing Egypt on its routes south into Africa, serving Tripoli on some flights and flying Rome-Khartoum direct on others.

• **Sabena canceled** service to Tel Aviv and its Belgian Congo flights will operate via Nairobi instead of Cairo. The Belgian airline also was affected by Russia's satellite troubles: a service to Vienna, Budapest and Warsaw, scheduled to begin last Thursday, was to be inaugurated only as far as Vienna.

• **Scandinavian Airlines System** flights were expected to be inoperative to, from and over Israel, Egypt, Lebanon, Syria and Iraq. Affected routes will terminate before reaching or be routed around those areas. SAS also canceled a flight to Rome, Damascus and Abadan.

• **KLM Royal Dutch** Airlines indefinitely suspended two weekly Amsterdam-Tel Aviv flights, rerouted a Dusseldorf to Bagdad schedule via Tehran instead of Cairo.

• **Air France** suspended Cairo service, was still serving Tel Aviv.

• **Swissair** suspended service to Beirut, Damascus, Tel Aviv and Cairo.

A spot check of airlines' New York offices disclosed a surprisingly small number of eastbound cancellations as of Wednesday. Some carriers had no cancellations, others only a handful.

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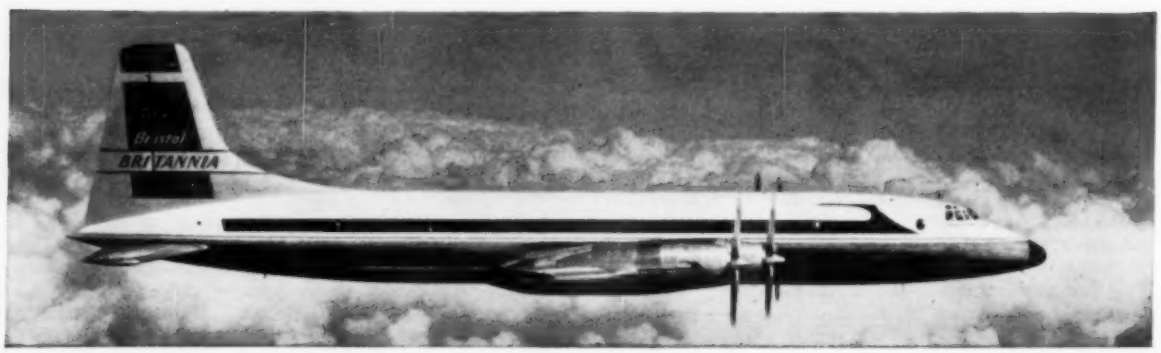

U. S., Colombia Sign New Air Agreement

Washington—A U. S.-Colombia bilateral air transport agreement has been negotiated to replace the Kellogg-Olaya Pact that has governed commercial air relations between the countries since 1929.

The new agreement is based upon the Bermuda principles that govern most of the 45 air transport pacts the U. S. has with other nations. It becomes effective Jan. 1, 1956, pending ratification by the Colombia Government.

Major immediate effect of the new agreement will be to allow Braniff Airways to begin serving Bogota, the Colombian capital. Braniff has U. S. rights to serve the city but has never been able to inaugurate service.

The U. S.-Colombia pact provides these routes for American carriers:

- **U. S. territory to Barranquilla,** Bogota, Leticia and beyond to points in the Western Hemisphere.
- **U. S. territory to Cali** and beyond to points in the Western Hemisphere.
- **U. S. territory to Medillin.**

Pan American-Grace Airways currently serves Cali on its flights between the U. S. and South America. UMCA (Uraba, Medillin and Central Airways), a Pan American World Airways affiliate, operates between Panama and Medillin.

These routes are provided for Colombian airlines in the agreement:

- **Colombian territory to New York** and beyond to points in the Western Hemisphere.
- **Colombian territory to Miami** and New York.
- **Colombian territory to San Juan,** Puerto Rico, and beyond to Europe.
- **Colombian territory to New Orleans.**

Avianca, Colombian National Airways, another Pan American affiliate, currently operates between Colombia and New York and Miami. It also operates a service to Europe via Bermuda.

PAA Tourist Seat Plan Turned Down by CAB

Washington—Civil Aeronautics Board last week expressed disapproval of Pan American World Airways' plans to operate DC-7Cs in tourist service with fewer seats than minimum required.

The CAB deferred action "with a view towards eventual disapproval" on the International Air Transport Assn. agreement that would grant Pan American an exception.

The DC-7C minimum for tourist service is 77 seats, but Pan American wants to operate with 76 seats on DC-7C tourist aircraft when a cloak room is installed.

The CAB found the proposal inconsistent with its position on tourist class seating. The Board has been actively campaigning for higher seating densities on international tourist aircraft since February.

At that time, the CAB expressed strong disapproval of current arrangements and forced IATA carriers to make changes in the fare structure on the North Atlantic routes.

In its opinion, the CAB admitted having approved a similar exception for British Overseas Airways Corp., but the Board pointed out that the BOAC proposal was presented along with an entire resolution prescribing standards for tourist service, not as a single issue.

Local Airlines Chosen For Braniff Routes

Washington—Frontier Airlines and North Central Airlines were chosen by a Civil Aeronautics Board examiner last week to supplement Braniff Airways' service to points along its Route 26.

North Central was favored by Examiner Paul N. Pfeiffer to serve stops in Nebraska, South Dakota and North Dakota on Route 26 that Braniff has been trying to abandon in a year-long battle with CAB (AW July 9, p. 43).

Along with the new North Central service, Pfeiffer recommended that Frontier be authorized to compete with Braniff on the trunk carrier's route between Bismark, N. D., and Sioux Falls, S. D. via Aberdeen, Huron and Mitchell, S. D.

North Central will fly between Grand Forks, N. D., which it now serves, and Omaha, Neb., via Fargo, N. D., Watertown, Brookings, Sioux Falls and Yankton, S. D., Sioux City, Iowa, and Norfolk, Neb., if the CAB accepts Pfeiffer's report. Watertown, Brookings, Yankton and Norfolk would be served on a flag-stop basis.

The examiner advised the Board to authorize Frontier and North Central to operate one roundtrip a day over each of the two new routes and said the routes should be granted on the condition that the two local carriers schedule a reasonable connection at Sioux Falls, the junction point. The new authority would be valid until 60 days after decision is reached in the Seven States Case.

The break-even subsidy need for the new services is estimated at $111,000 a year for the daily round trip between Grand Forks and Omaha, and $100,000 a year for the Bismark-Sioux Falls daily round trip.

UAL Orders Collins Proximity Indicators

Chicago—United Air Lines ordered 250 airborne proximity indicators at a cost of $1,750,000 from Collins Radio Company. Deliveries of the equipment are scheduled to begin in September 1958.

UAL's board of directors approved the purchase at an Oct. 25 meeting, at which a regular quarterly dividend of 37½ cents per common share of United stock was declared.

Midway Is Busiest Airport in '56

Washington—Chicago Midway retained first place as the nation's busiest airport in all categories of aircraft operation during Fiscal 1956, according to the semi-annual summary issued by the Civil Aeronautics Administration.

The Chicago tower handled 366,079 operations exclusive of local flights during the period. It was followed by New York's LaGuardia, with 260,661 operations, and Washington National, with 237,590.

Los Angeles was fourth, Dallas fifth and Atlanta sixth with Miami, Albuquerque, St. Louis and Cleveland completing the first 10 in this grouping.

In the category which includes local as well as air carrier and itinerant operations, Chicago was first, followed by Miami, LaGuardia, Los Angeles, Atlanta, Denver, Charleston, S. C., Washington, Teterboro and Phoenix.

Los Angeles replaced Chicago Midway in first place for the number of instrument approaches handled by its tower. During Fiscal 1956, San Diego was second and Chicago third in this grouping. Others in the first ten were Portland, Cleveland, Seattle-Tacoma, Pittsburgh, San Francisco, LaGuardia and Anchorage, Alaska.

The CAA reported a 27% increase in the number of instrument approaches handled by all CAA control towers. The total of 583,200 instrument approaches handled during the year was almost double that handled five years ago.

Aircraft operations reported by CAA towers amounted to 20,384,000 during Fiscal 1956, an 8% increase over the total reported during Fiscal 1955. General aviation itinerant and local civil operations comprised 45% of the total, air carrier 30% and military itinerant and local traffic 25%.

Fix postings recorded by the federal airways system reached 22,891,000 during the period, a 23% increase over the previous fiscal year.

Aircraft contacted by interstate airway communication stations total 7,655,000 or a 12% increase over the previous corresponding period.

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CAB Votes to Outlaw Two More Nonskeds

Washington—Civil Aeronautics Board will put two of the last of the nonscheduled aircoach operators out of business when it revokes the operating authority of Peninsular Air Transport and Acro Finance Corp.

Because of economic violations of law, the board has voted to revoke the Letters of Registration under which Peninsular and Acro Finance have operated.

The CAB decision will become official as soon as its staff can prepare an opinion and order.

The revocation decision goes far beyond the recommendations of Examiner Edward T. Stodola in his report on the case. Stodola found the two carriers guilty of combining operations and offering a regular service, but he recommended a 90 day suspension.

The examiner said that, since the CAB has made a new set of rules for large irregular carriers, Peninsular and Acro Finance should have an opportunity to operate under them and have another chance to show good faith.

The Peninsular-Acro Finance revocation follows by more than a year similar action taken against the carriers in the Trans American Airlines group. The Trans American revocation was appealed, and the appeal is still awaiting a court decision.

The two irregular carriers also are under fire from the CAB for safety violations. Last month, an examiner found them guilty of various safety violations and ordered their operating certificates revoked. The carriers forestalled this revocation by appealing the decision.

In another case before the CAB, Southeast Airlines Agency and allied groups have been found guilty by a CAB examiner of violating the regulations for ticket agents. These ticket agencies sold tickets for Peninsular and Acro Finance.

CAB Approves Merger Of Mackey and Midet

Washington—Mackey Airlines' plan to take over Midet Aviation Corp. was approved last week by CAB and President Eisenhower.

Mackey will trade 100,000 shares of its common stock for Midet's assets—mainly its route between West Palm Beach and Miami and West End, Grand Bahama Island, B.W.I.

CAB approval of the Mackey-Midet deal specifies that assets taken over by Mackey be entered on Mackey's books at the book value on the date of transfer. The deal also is subject to the usual labor protective provisions established in the Slick-Flying Tiger merger case.

Acquisition of Midet's route is another step in Mackey's expansion program in the Florida area. Earlier this year, Mackey was granted a new Florida-Havana-Nassau route which permits the carrier to operate the only triangular service between the three points.

Shortlines

► **Airlines Clearing House** business totaled $57,469,935 in September, an increase of 12% over transactions of September 1955.

► **Seattle-Tacoma** International Airport handled 127,750 passengers in September, a 10% increase over September 1955, traffic.

► **Swissair** is offering "Manhattan Showcase" tours of New York as stopover entertainment for passengers traveling to and from Europe. The package tours offer various combinations of accommodations, entertainment and tickets to popular Broadway shows for prices ranging from $29.50 to $162.50 per person.

► **Avianca**, the Colombian airline, has opened a new maintenance shop at Barranquilla. The carrier can overhaul aircraft up to the Super Constellation

Honolulu's New Jet Airport

New facilities will be added to present Honolulu International Airport and Hickam Air Force Base to create Hawaiian Aeronautics Commission version of "modern jet airport." Plans call for an additional 12,000-ft. USAF runway to enable jets to take off seaward, thus avoiding city of Honolulu. Funds have been lopped off Fiscal 1958 Defense Budget, but commission is attempting to have them reinstated. Plans for improvements to cost $5 million, provide for seven-story administration building, two-story control tower, parking space, landscaped islands and terminal to be divided into four areas to take care of various classes of passengers—those departing overseas, foreign arrivals, and inter-island arrivals and departures.

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► **British European Airways** has begun a London-Lydda service, replacing British Overseas Airways Corp. services that were dropped last year. The new service between Israel and England operates twice a week via Rome, Athens and Nicosia.

► **California Eastern Aviation** reports a net income of $736,586 after taxes for the first nine months of the year, a 60% increase over earnings for the same period of last year. Total sales for the 1956 period were $27,276,799 as compared with $18,769,225 in sales for the first nine months of 1955.

► **Copenhagen's Kastrup Airport** will be expanded to handle increased traffic and upcoming jet operations under a proposed $24 million government program. Expansion plans include $10.4 million for a new terminal, $11 million for runways and $2.7 million for access roads.

► **Flying Tiger Line** reports freight traffic of 16,321,325 ton-miles for the third quarter, as compared with 13,958,089 ton-miles in the July-September period of 1955.

► **Guest Airways** has started a cut-rate Mexico City-Guatemala City-Panama service with DC-4 and Constellation equipment at fares about 20% below those charged by such carriers as Pan American World Airways, Taca International Airlines and KLM Royal Dutch Airline, all of which operate in the area.

► **KLM Royal Dutch Airlines** has reached agreement with the Rumanian state airline on inauguration of service between Amsterdam and Bucharest. Service will start as soon as the Bucharest Airfield has been modernized.

► **Northwest Airlines** has signed an interline agreement with Chicago Helicopter Airways for service between Midway and O'Hare Airports in Chicago. Northwest passengers will be able to transfer between the two airports in 12 minutes at a fare of about $5.

► **Real Airlines of Brazil** has extended sales activities in Florida with the opening of a new office in Jacksonville.

► **Sabena Belgian World Airlines** begins a second weekly DC-6A passenger-cargo flight this week between New York and Brussels. The DC-6As carry 9,000 lb. of freight and 38 passengers on the combination flights. Sabena reports its cargo traffic on the North Atlantic is up 60% in the first nine months of the year over the same period in 1955.

AIRLINE OBSERVER

(EDITOR'S NOTE: *The following column was written by* AVIATION WEEK *staff members attending the Radio Technical Commission for Aeronautics' 1956 Fall Assembly at the Civil Aeronautics Administration's Technical Development Center in Indianapolis.*)

► Technical Development Center is seeking a replacement for existing horizontal displays of radar. Specifically required is a unit that would provide overhead projection, a high degree of brightness, good resolution and controllable erasure. Displays must be inherently stable and trouble free.

► **Only U. S. wind tunnel tests for fire detection are being conducted by the Technical Development Center, although its 175 mph. wind tunnel operated by 4,200 hp. electric motor is inadequate for jet engine tests. Within next two months, however, the center will begin fire detection and flame path tests on a Pratt & Whitney J57 turbojet engine installed in a Boeing 707 pod with pylon and 12-ft. wing section.**

► Aeroflot was represented at RCTA's 1956 Fall Assembly by a party of three Russians headed by A. Ivoninski, chief of air traffic control for Aeroflot. The party is visiting the U. S. under State Department jurisdiction.

► **Recent tests conducted by the Technical Development Center indicate that a heliport properly designed can handle a total capacity of 216 helicopter and VTOL aircraft operations per hour.**

► Television interference in the VHF aviation band has been observed in certain areas, including Detroit, Syracuse and Teterboro, N. J. Television station operators have shown cooperation by incorporating suppression techniques in transmitters that eliminate or greatly reduce interference. Some interference has been generated within airborne VHF receivers and manufacturers are now redesigning newer units to prevent this self-induced interference. In older airborne VHF receivers, a simple high-pass filter can be added to antenna lines to eliminate television interference.

► **The 64 codes inherent in the air traffic control radar beacon's six identification-pulse system may be authorized by the CAA, although military services originally proposed use of only 10. Studies are now being conducted by a special RTCA committee to determine whether additional codes can be made available.**

► Problems of providing adequate communications in civil aircraft increase inversely with the size of the aircraft. For larger airplanes, satisfactory VHF communications systems weighing between 30 and 40 lb. are becoming available at a cost of $2,000 and up. For small, single-engine aircraft, 40 lb. is an appreciable part of the payload, and the cost of equipment that will give desired flexibility often approximates the cost of the airplane.

► **Radar coverage is being provided the Technical Development Center to permit tests of a complete radar environment for both terminal and en route areas. Radars used in the test include two basic types of Air Defense Command radars at Rockville, Ind., and Bellefontaine, Ohio; a long-range radar operated at Jamestown, Ohio, by Wright Air Development Center, and an FPS-8A radar supplied by the Air Force for installation at Indianapolis.**

► Commercial airlines are expected to equip a portion of their fleets with transponders for in-service evaluation tests of air traffic control radar beacon systems being installed in the New York, Washington and Chicago areas. CAA's Flight Inspection Division, Technical Development Center and military aircraft probably also will participate in the tests.

► **Additional traffic control equipment of the type in use today and more controllers will not improve high-density traffic situations which create overloading of communications required for position reporting and other problems, according to TDC officials. They are depending upon a vigorous research and development program to solve air traffic control problems in high density areas.**

Starting in a Cabbage Patch . . .

Jim hit pay dirt!

Jim Nissen and the city of San Jose teamed with Shell. The result —a bustling airport in a field where cabbages once grew.

TODAY, the fleet of Shell trucks at San Jose Municipal Airport is pumping ten times more fuel than seven short years ago. And with manager Jim Nissen's plans for a 1200-acre field in the near future, the gallonage will keep right on going up.

It all started in 1946 when Jim built a small airport on a 16-acre cabbage patch . . . one hangar and an office. But it didn't take him long to outgrow these 16 acres.

One year later, he added an additional 64 acres to handle the booming air traffic. But

before long even that wasn't enough to take care of all the business flying his way.

When the city of San Jose took over the field for a municipal airport in 1948, Jim stayed on as top man and Shell was chosen to "join the team."

In Jim's own words, "Service is what sells in this business. For example, we handle about 10,000 flights a month—including 14 flights a day by Southwest Airways. With traffic like this, we've got to get every plane off *on schedule*. And we do—thanks to our modern equipment, which Shell has designed to help save time in every service operation.

"And with traffic getting heavier every month, we spend a lot of time working out the new problems with Shell aviation specialists. We also make good use of the service tips in the Shell dealer magazine.

"And it's paid off! Corporations like Ford, Rexall, Reynolds Metal, Sears Roebuck, Monsanto Chemical and Fleischmann's Yeast use our airport. What's more, Shell is helping us get more *new* business every month."

All in all, Jim Nissen has guided the spending of over $2,000,000 developing that one-time cabbage patch. The results are impressive: in 1948, 20 private planes were based at the airport. Today 100 planes are based there, including 46 corporate aircraft. And there's a long waiting list for hangar space.

The airport's facilities include a restaurant that attracts non-flying residents of San Jose as well as fliers . . . taxi and car rental services . . . and a large, modern maintenance shop.

Yes, wonders have been worked in that cabbage patch—thanks to the team of Jim Nissen, the city of San Jose and Shell.

Ted Simon, who operates a crop-dusting service from the field, likes the way Shell service keeps his planes on the job.

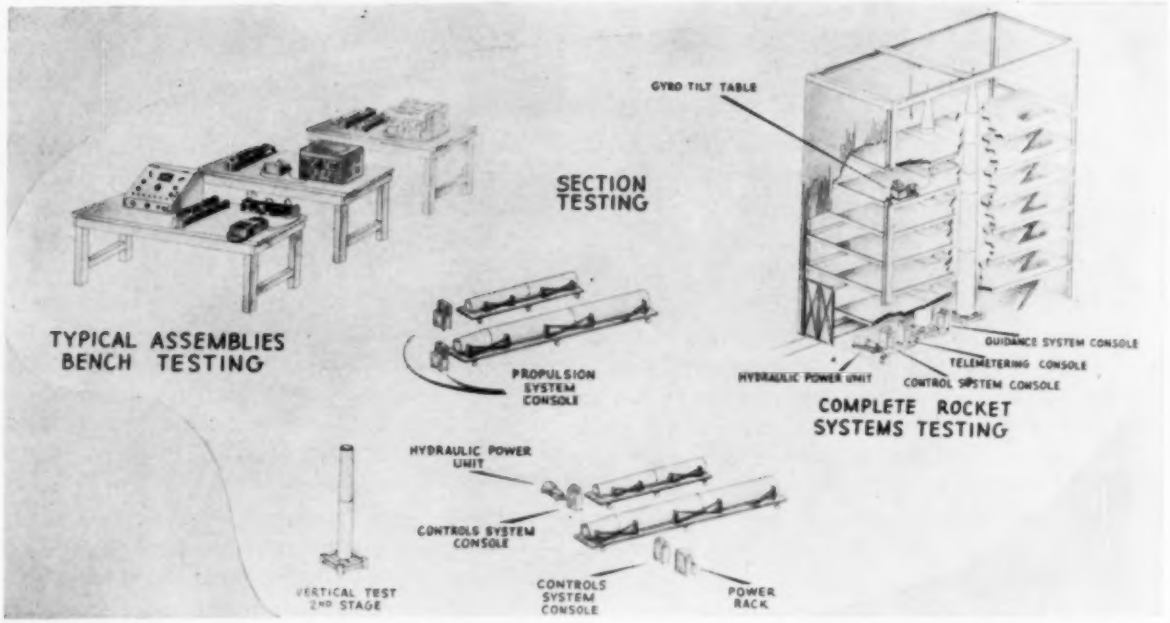
Jim talks over newer, better service methods with Bob Wright, co-owner of the field's maintenance shop.

Jim watches the field's expansion closely. Here he checks plans for the new 1200-acre field with his assistant, Jack Harper.

It pays to be a Shell Aviation Dealer

—and the Shell office nearest you will be glad to show you why

SHELL



TWO VANGUARD three-stage rocket launching vehicles may be tested simultaneously in the seven story assembly and test tool structure at Martin's Baltimore plant. Tests include propulsion system, hydraulic power and controls systems.

Vanguard Depends on Tools and Gages

By David A. Anderton

Flight performance of the Vanguard is the controlling requirement in Martin Company's manufacture of the earth satellite vehicle.

The two factors that determine whether the Vanguard will be a satellite or a meteor—its final velocity and angular heading exert their influence far into structural design, manufacturing precision and testing adequacy.

• **Final velocity** is almost directly proportional to the ratio of the total loaded weight of the Vanguard to its satellite payload. With the best current design techniques, it will take about 1,000 lb. of structure, powerplant and guidance to place each pound of the satellite payload in an orbit. Each pound saved in structure pays off in increased final velocity.

• **Final angular heading** depends on the precision of steering, which in turn depends partially on the precision with which the Vanguard's control systems are fabricated and installed.

Structural Weight

Overall structural weight of the three-stage Vanguard vehicle is approximately 14% of the gross weight, or about 3,100 lb. This figure seems low for multi-stage rockets, although no comparative data exists. Comparison with single-stage rockets is not a fair one, because it is easier to build a lightweight single unit of structure than to triplicate that structure to different scales and combine those three pieces.

Basic dimensions of the Vanguard: 72 ft. long, 45-in. first-stage diameter and 32-in. second-stage diameter. Gross weight ready for launching is approximately 22,000 lb.

The first stage will differ considerably from the Martin Viking, often reported as the prototype first stage. Vanguard's first will be longer and will have much simpler structure, designed around the concept that the first stage is simply a powerplant to get the vehicle moving.

Major components of the first stage are the two propellant tanks and a single powerplant and accessory section. The tank walls are the external skin of the first stage.

Tanks are formed in halves of aluminum sheet, supported by two channel-section frames and the header bulkheads of the tank ends. An aluminum extrusion reinforces the joint between skins and headers. Spotwelding and fusion welding are used to join the metal parts and to make the joint leakproof.

The engine section is made of aluminum frames and stringers in the conventional manner, skinned with riveted magnesium sheet.

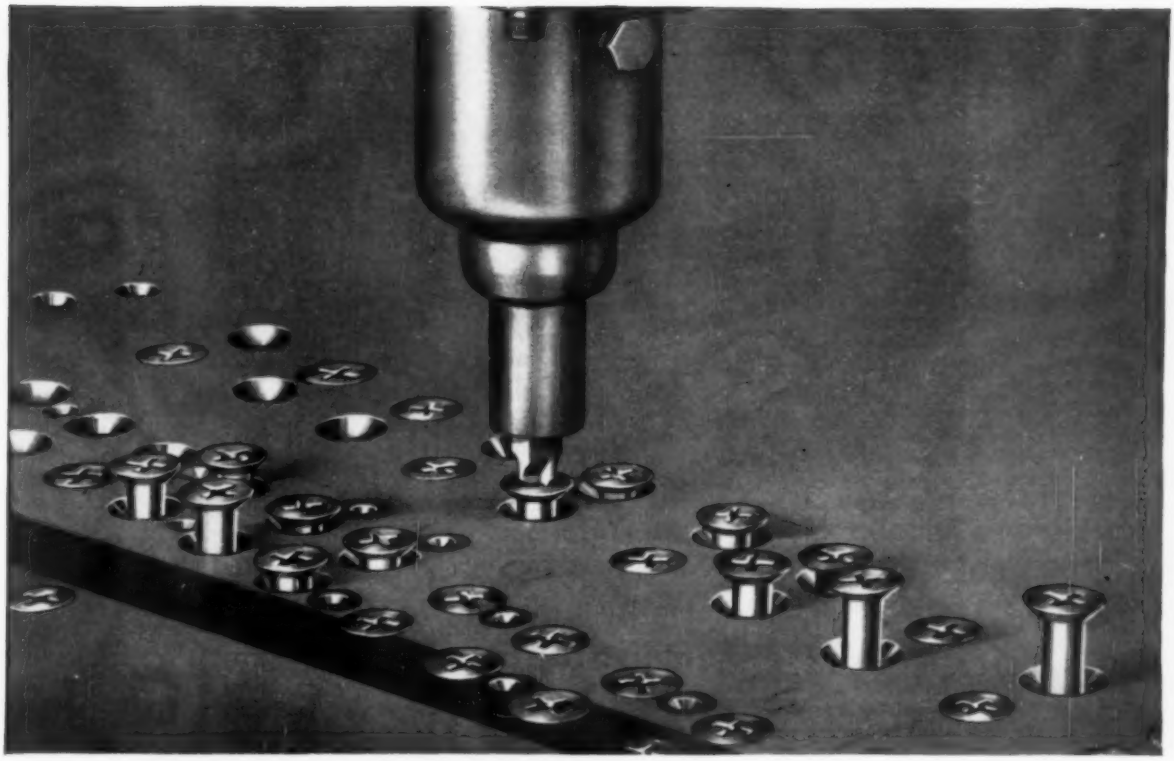
The transition section between the first-stage tanks and the second-stage is also aluminum frame and stringer construction with magnesium skins. This section reduces the 45-in. diameter to 32 in.

Second Stage Structure

Martin will only build the forward portion of the second stage, which will be basically a guidance package and the supporting and jettisoning structure for the third-stage and its turntable. The rear portion of the second stage is the powerplant bay and will be completely fabricated by Aerojet General Corp.

The Aerojet portion will use 17-7 PH stainless steel in the tanks because of the corrosive propellants: nitric acid and unsymmetrical dimethyl hydrazine. Martin will build its portion of aluminum and magnesium.

The guidance system for the entire Vanguard vehicle will be in the forward section of the second stage. The second stage also contains the turntable on which the third-stage is mounted and which allows the third-stage to be spun up by small solid-



NEW TORQ-SET FASTENER FOR AIRCRAFT*

*GREATEST WRENCHABILITY KNOWN

American's new TORQ-SET fastener is the only one of its kind available today with a wrenching recess capable of delivering Torque values far in excess of present aircraft requirements.

It's because TORQ-SET's driving walls are parallel with the screw axis — forming a direct axis for driving. For example, the average torquing ability of the 9/16" TORQ-SET is 2540 inch pounds, 58% higher than actually required.

The exclusive recess design of TORQ-SET allows power driving, yet removal without difficulty. Supplied in high strength alloy steels, (including the newer heat-resistant types), TORQ-SET affords high wrenchability without burring or distortion. On-the-job performance shows uniformly smooth surfaces, eliminating the need for refinishing.

TORQ-SET is produced as a completely forged product making possible unlimited production enhanced by the fine physical properties of forging. Find out how TORQ-SET can be applied to solve your production problems. Write or call today. American Screw Co., Willimantic, Conn.

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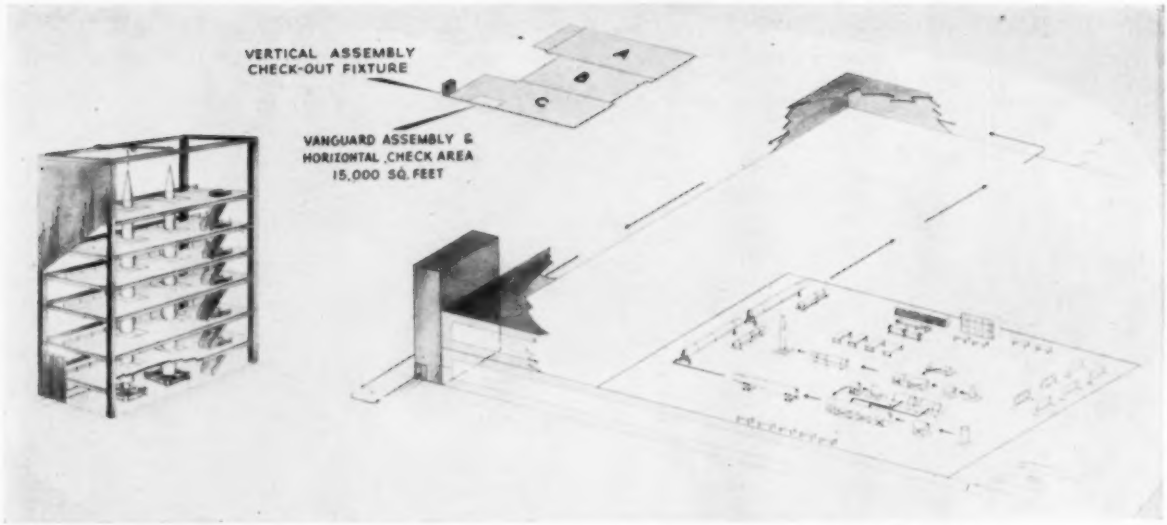
West Coast Sales Office and Warehouse: Air Industries of California, 922 W. Hyde Park Blvd., Inglewood, California



FLOOR PLAN for Vanguard assembly and check area shows seven-story test tool, placement of area within plant.

propellant rockets just before separation. Mechanisms and fittings for ejection are also in the forward second stage.

The third stage is being developed in parallel by Grand Central Rocket Co. and the Allegany Ballistics Laboratory as a solid-propellant powerplant. Because it has no guidance or control means, it is spin-stabilized before its separation from the second stage.

The nose cone protecting the satellite during the ascent is separated and detached from the second stage sometime after first-stage burnout and before third-stage spinup.

Fixtures to check installation dimensions for the first and second-stage powerplants will be made at Martin and sent to General Electric and Aerojet. These will be made from a master gage also built by Martin.

Alignment between the stages also will be guaranteed by sets of these checking fixtures made from Martin masters. Third-stage and satellite positioning will be checked the same way.

Four tiedown points will be matched to corresponding points on the launching pad at Cape Canaveral near the Air Force Missile Test Center, Cocoa, Fla.

Testing Techniques

Standard and extensive static and dynamic tests on the airframe and structural components will be made by Martin technicians to check out the adequacy of the structural design of the Vanguard.

In addition, the unusual environmental conditions up to 300 mi. altitude will be simulated in checking operation of the components.

Pressure testing of the tanks begins in the standard fashion, using helium at low pressure inside the tanks and soapsuds to find leaks. If the tanks pass this, they are mounted vertically, filled with water and pressurized to simulate the propellant feed conditions. If there are again no leaks under the pressure head, the water is removed and weighed to calibrate the tank capacity.

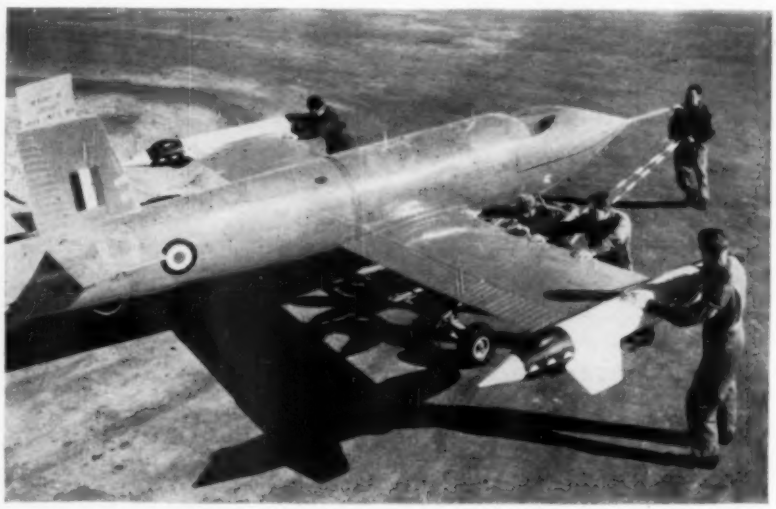
Last step is cleaning the tanks, done with detergent and water under pressure. The spray nozzle moves up and down in the mounted tank, and spins in both horizontal and vertical planes.

The detergent is drained, the tanks are rinsed and then dried with hot air. The same spray nozzle is used to apply a chromodizing coat to the tank interior.

Helium is pumped into the cleaned and sealed tank at about two pounds pressure to prevent condensation or contamination between the construction and the launching dates.

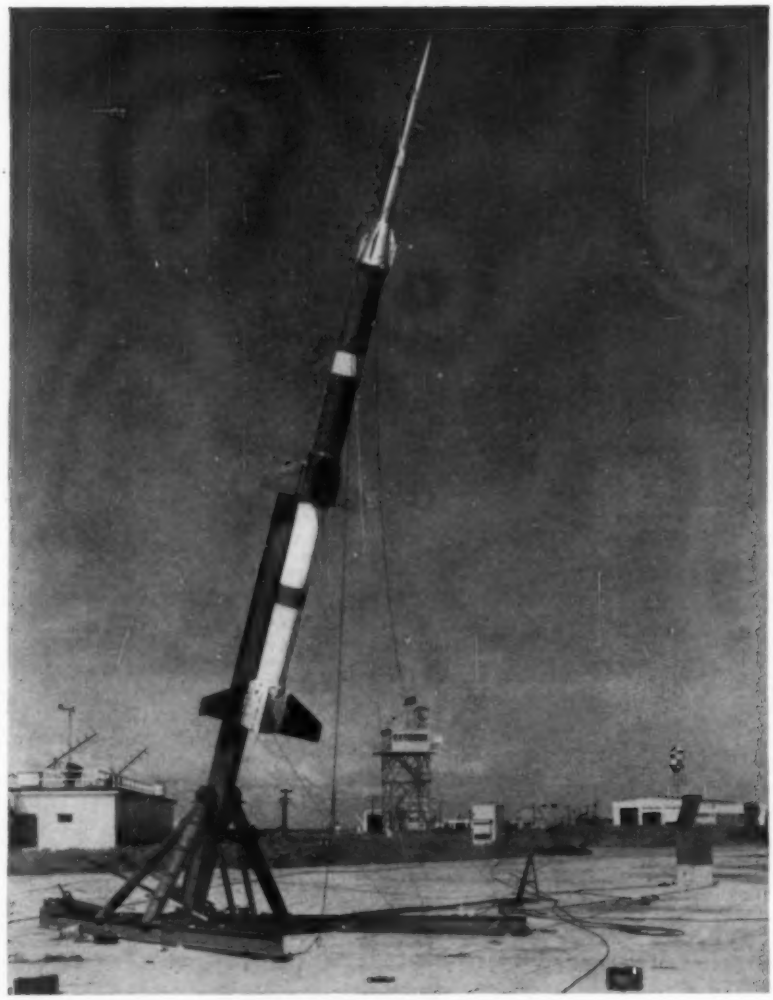
Final assembly and test will be done in a 90-ft. high fixture in a special building at the Martin plant in Baltimore. Two rockets can be checked out in this fixture at the same time.

First and second stages are separated for handling ease and trucked separately to the firing site.



Jindivik 2 Rolls Out

Australian Jindivik 2 pilotless drone is wheeled out for run at Woomera range. Wing tip pods carry camera to record miss-distance of weapons fired at it. Powered by Armstrong Siddeley Viper turbojet, Jindivik is rolled out on trolley, lands on skid.



Mach 10 Rocket

Four-stage hypersonic test vehicle developed by National Advisory Committee for Aeronautics reached Mach 10 in program to obtain ICBM data. Vehicle uses two Nike boosters in tandem and two smaller solid propellant charges. Fourth stage model (below) shows blunt nose and flared tail of ICBM.

avien's 'piggy-back' thervel* switch

adds positive level control to any fuel gage

Avien . . . pioneer in the development of aircraft fuel management systems . . . now brings dependable fuel level control to any fuel gage installation.

Employing Avien's service-proven thermistor switch in a new clamp-on design, the "piggy-back" sensor mounts on any tank probe — provides precise level signals for high- or low-limit warning, tank sequencing and other fuel management jobs. External relay unit eliminates moving parts from the tank, assures reliable control of signal lights, pumps or valves.

Weighing less than 0.5 pound, the "piggy-back" Thervel Switch uses only three wires between units; is adaptable to any fuel system without altering present equipment.

Most important — operation is independent of fuel gage circuits, providing positive level monitoring even under emergency conditions.

Additional features:

- **Operates from standard 28 volt DC supply**
- **Unaffected by slosh, vibration or acceleration**
- **Requires no additional mounting holes**
- **Conforms to MIL-E-5272A and MIL-G-9515 (ASG)**

Other Models: Available in 12 volt and bracket-mounted models, as well as special designs.

For complete specifications and application data write Dept. AW-11

*TRADEMARK

Avien

Precision Instruments and Control Systems
58-15 Northern Blvd., Woodside 77, N. Y.

IMPORTANT DEVELOPMENTS AT JPL

Central Recording Systems for Rocket Engine Tests

The Jet Propulsion Laboratory is a stable research and development center located to the north of Pasadena in the foothills of the San Gabriel mountains. Covering an area of 80 acres and employing 1450 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Inquiries leading to employment of qualified personnel are now invited.

The Jet Propulsion Laboratory pioneered in central recording of rocket engine measurements when in 1948 the Laboratory established its first system serving five engine test cells.

From this early beginning involving but a few instruments, central recording systems both at the Laboratory and elsewhere have expanded to the complex multi-channeled systems now required for modern-day development of missile systems.

The central recording system combines recorders, transducers, amplifiers, carrier systems, control networks, calibrating standards, wired-telemetry channels, and special devices into an integrated complex to measure the multiplicity of variables of a rocket engine test. Through flexible interchanges of communications channels the entire system becomes available for engine tests progressing at any one of many rocket engine test cells accomplishing an economy of instrumentation investment and operation with improved reliability.

Among the special devices, the Laboratory introduced high-speed encoding of instrumentation-level voltages, on-line computation of rocket-engine performance parameters, and rotary-element flowmeters for hazardous fluids. The Laboratory is in the forefront of the development of missile-system instruments such as transducers, recorders, standards, controls, data-transmission and data-handling systems, and computers.

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JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY
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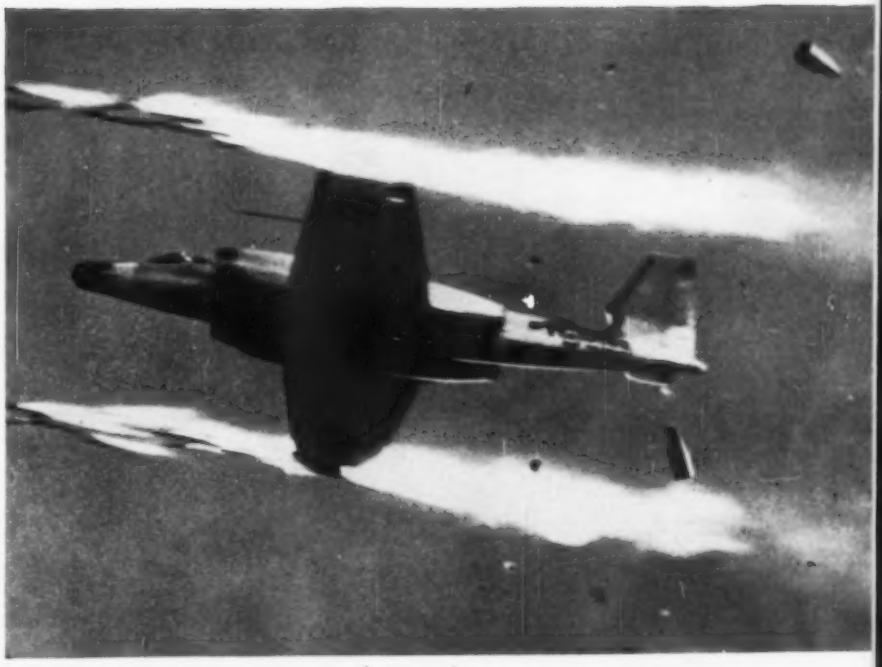
Bearing-Lubricant Center Opened by GE

General Electric Co. last week opened its $1 million bearing and lubricant center at Schenectady, N. Y., designed to explore technological changes that will be wrought by jet engines, missiles and satellites.

Dr. Robert O. Fehr, manager of mechanical engineering for the company's General Engineering Laboratory, said that forward looking engineers are studying such concepts as air bearings to minimize friction, and molten metals and molten glass as lubricants, to cope with speeds up to Mach 25 and temperatures of 1,000F.

General Electric, he said, already has designed bearings lubricated by liquid metals, strong acids, gasoline and air. Much attention will be devoted to air lubricated bearings, he said, because of the possibilities for use in high speed, high temperature applications. New concepts of balanced gravitational and centrifugal forces will be explored.

"Since the beginning of time," Fehr said, "the Earth has rotated around its own axis without bearings and without lubrication, held in space by mass forces. Engineers are looking for ways to apply these principles to the rotating equipment of the distant future. We are



Rocket Fury

Flame shoots from wingtips of Royal Canadian Air Force CF-100 as it fires its rockets over practice range at Cold Lake, Alta. Debris and objects falling from plane are rear cones of wingtip pods.

Integral fuel tank before desealing.
Tank desealed by CEE-BEE recirculating spray method.
CEE-BEE repaired and resealed tank.

CD 456

There's Only One Seal That's GUARANTEED!

It's the CEE-BEE method for desealing, repairing and resealing aircraft integral fuel tanks. CEE-BEE's products and methods eliminate danger of fire or explosion. Cost studies, based on DC-4, show savings up to $12,000 per ship – plus minimum "out of service" time – another money saving feature. CEE-BEE service, experts and equipment are available when and where you want them – anywhere in the world – to direct and supervise. Write for complete information.

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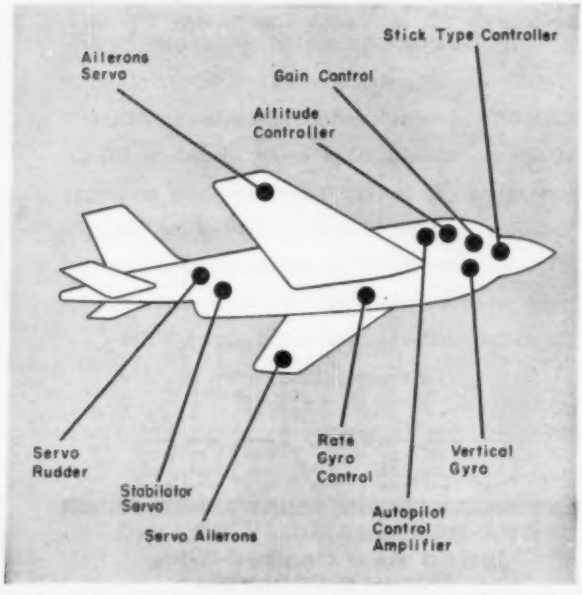
CEE-BEE CHEMICAL CO., INC.
9520 East CeeBee Drive
Downey, California

The Navy's new fighter-interceptor, the McDonnell F3H-2N Demon, joins the Pacific Fleet, with General Electric G-3H Flight Control System.

How General Electric Flight Control System Improves F3H-2N Demon Effectiveness



G-3H Automatic Pilot Components and their location in the Demon

The Demon is a more effective fighting weapon because the General Electric G-3H Flight Control System makes it a stable gun platform, and provides automatic pilot relief and maneuvering functions : : . leaving the pilot free for other vital duties.

Serving as an electronic "co-pilot" in this one-man fighter-interceptor, the autopilot can be set to hold a constant altitude, heading, climb or bank angle. By providing flight stabilization, the G-3H system steadies the Demon without increasing drag—improves performance —helps the Demon to more effectively accomplish its mission.

To find out how a G-E Flight Control System can be designed or adapted to fit your needs, contact your nearest G-E Aviation and Defense Industries Sales Office. General Electric Co., Section 221-8, Schenectady 5, N.Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

confident these new concepts will lead to dramatic technological changes."

The new center combines GE's bearings and lubricants development facilities formerly divided between the Thomson Laboratory at Lynn, Mass., and the General Engineering Laboratory.

It has a staff of 30, including 14 engineers. It is expected to double its personnel in the next few years.

Harry Apkarian is manager of the center, and Dr. Beno Sternlicht is technical director.

Public Sees Atomic Delivery Competition

Los Angeles—First public showing of special weapons delivery competition (atomic tactical bomb) highlighted the 1956 Fighter Weapons meet at Vincent AFB, Yuma, Ariz., and Nellis AFB, Las Vegas, Nev.

Opening of the special delivery event to the public was brought about after a special appeal to the Pentagon by Brig. Gen. Dale O. Smith of USAF plans and policies.

Pilots of F-84G and F-84F and F-86 fighter-bombers carried practice weapons having the same general configuration as the actual atomic weapons. Spectators at the range near Pork Chop Lake, Nev., saw the fighter-bombers employ the "over the shoulder" toss bombing technique, which has been demonstrated previously elsewhere, but not at the fighter weapons meet.

Winners of the meet:

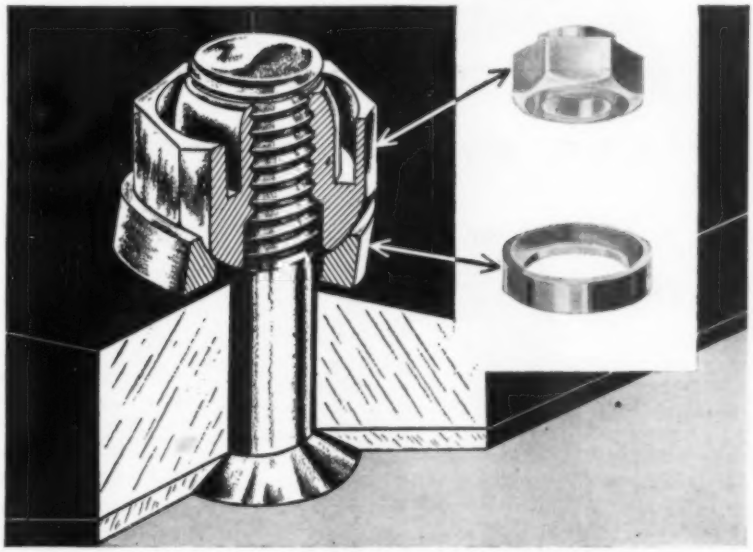
• **Yuma, in rocketry,** Eastern Air Defense Force team, 13,800 points flying F-86Ds. Individual high score was EADF's Lt. Robert B. Long, with 4,800 points out of a possible 6,000. Win was second straight for EADF, represented this year by 30th Air Division and last year by 26th Air Division.

• **Nellis, in gunnery,** Air Training Command's Nellis team, with 3,644.8 points flying F-86Hs. High individual scorer was Nellis' Capt. Asa Whitehead, who took first in dive bombing, air-to-ground, 20,000 ft. air-to-air, and air-to-air.

• **FEAF's** Capt. Ralph Ashby won the individual skip bombing, and another ATC man, Capt. Calvin Davey, captured the low-angle strafing crown. In the Nellis air-to-ground rocketry competition, FEAF's 1st Lt. Robert Lilljedahl was top man.

• **Nellis,** in the special weapons phase USAFE took top award with 50,588 points flying F-84Fs. Col. Richard Hunziker, captain of the 506th Strategic Fighter Wing team, won the high team captain award. In dive bombing, top scorer was FEAF special weapons team captain Col. William Chairsell. Low angle bombing winner was Capt. William B. Ragon of the 474th Fighter

FASTENER PROBLEM



Hex nuts to fasten non-parallel surfaces

To fasten non-parallel bolting surfaces, many time-consuming operations like spot facing, step milling, or hand selecting tapered shims have always been necessary. As more and more forged and extruded structural members and tapered skins are used in aircraft and industrial design, these preparations have become an increasingly expensive and time consuming problem.

ESNA's new counterbored, self-aligning hex nut solves the problem by tilting up to 8° in any direction from centerline. Its design is based on the ball joint principle. The convex-shaped base mates with a concave alloy steel precision washer, and tightening the bolt in the normal manner automatically seats the nut in the base and adjusts it to the proper angle. Because no special adjustments or tools are required, significant production speed-up is assured.

ESNA's AN-approved Type LH self-locking device provides positive protection against the nut loosening due to vibration, and assures extended reusability. Performance is to AN-N-10 and/or MIL-N-25027 (ASG) specifications for temperatures up to 550°F. Thread sizes are 10-32, 1/4-28 and 5/16-24.

MAIL COUPON FOR DESIGN INFORMATION

ESNA

Dept. N19-1125, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastener information:

☐ **Standard drawing of nut Type LH2935**

☐ **Here is a drawing of our product. What self-locking fastener do you suggest?**

Name_____ **Title**_____

Firm_____

Street_____

City_____ **Zone**____ **State**_____

NEW ALCOA PROCESS TAKES THE WARP OUT OF AIRCRAFT HAND FORGINGS

Note great difference in warpage between aircraft parts machined from hand forgings of X7079 in -T6 and -T65 temper. Yet, mechanical properties are the same. Original part is 5" thick, 11½" wide, 143" long.

Major technical advance saves machining, money, time

Up till now, hand forgings of aluminum in the high-strength heat-treated condition have had the unfortunate tendency to warp during machining, due to the presence of internal stress (see photo). The -T6 temper, now commonly used, gives you optimum mechanical properties but it may also mean extra machining, heat treating and straightening.

Well, a new day has dawned. Alcoa® can now supply hand forgings and rolled rings of X7079 alloy in the stress-relieved -T65 temper. These forgings have the same mechanical properties as found in -T6 temper but the warpage is practically nil—just about what you'd find in stretched plate and extrusions. In rolled rings, ovality caused by machining is reduced to a minimum.

We've supplied over 150,000 lbs of X7079 alloy in -T65 temper to a major aircraft builder and it has been thoroughly proved. So you can buy with assurance. This manufacturer used X7079-T65 to make parts of larger cross sections than have been made with 7075 or X7079-T6. They reported "uncountable savings in production time and machining costs."

So . . . for alloy X7079 in the -T65 temper, Alcoa will guarantee the same standard published properties now available within commercial heat-treat limits. Outside these limits we will negotiate guaranteed properties. The -T65 temper is also being applied to alloys 7075 and 2014 although sufficient data are not yet available to establish guaranteed properties in -T65 temper. (This we hope will come soon. Also, we hope to make die forgings in -T65 temper.)

This is another important "first" for Alcoa's Development Division and Research Laboratories. As we were first to develop stress-relieved sheet, plate, extrusions and rolled parts, now it's hand forgings and rolled rings. We think it is what you would expect from Alcoa. Aluminum Company of America, 1800-L Alcoa Building, Pittsburgh 19, Pa.

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Your Guide to the Best in Aluminum Value

Bomber Group special weapons team. Individual high in special weapons was won by Capt. Dee McCarter, 81st Fighter Bomber Wing, USAFE.

Runners up in the rocket phase were Western Air Defense Force in F-89Ds, while second team in Nellis gunnery competition was USAFE with 2,977.8 flying F-86Hs. FEAF, using F-84Gs, was runnerup to USAFE in the special weapons phase.

Other highlights of the dual gathering, in progress simultaneously at the desert air bases, included:

• **Presentation** to S/Sgt. Donald Vorst the trophy for best individual airman of the meet.

• **Dedication** of Yuma Air Force Base as Vincent Air Force Base, in honor of the late Col. Clinton Vincent.

• **Introduction**, at Yuma, of two new firing levels, 9,000 ft. and 35,000 ft. the lower targets were towed by TB-29 aircraft, the high targets by B-57s.

• **Introduction**, at Nellis, of a new target technique whereby targets are carried aloft by F-86 tow planes under the wing and dropped at the proper time, rather than dragged from the ground up.

• **Statement**, expressed by Vincent base commander Col. Milton Ashkins, that every effort is being made to introduce more realism into meets, for example, interception type missions instead of known times, locations, altitudes, speeds and target tracks. Also, Col. Ashkins said, it is hoped that integrated drone systems can be introduced within a year.

Presenting awards at the close of the meet was Gen. Thomas White, deputy chief of staff, USAF.

AEC Awards Nuclear Contract to Martin

Atomic Energy Commission awarded contract for undisclosed amount to Nuclear Division of Martin Co. for study and design of small heat source utilizing decay energy of reactor produced isotopes or reactor fission products. Martin says this application of nuclear energy could yield power source for systems requiring long-period, unattended operation. Such sources could deliver as high as 2,000 watts of heat energy continuously for periods up to five years.

GE Receives Missile Systems Contract

Missile and Ordnance Systems Dept. of General Electric Co. received multimillion dollar prime contracts from Army Ordnance Corps, Picatinny Arsenal Atomic Applications Laboratory, for production of recently developed arming and fuzing systems for guided missiles. Amount of contracts was not disclosed.

(Advertisement)

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

Now and then a Whittaker field engineer is surprised to hear the question:

"Why don't you people branch out a bit, broaden your line, increase your sales?"

Invariably the query comes from some engineer who works exclusively with hydraulics, pneumatics or fuel systems — an expert thoroughly familiar with Whittaker products in his own line, but with no conception of the valve company's versatility.

For Whittaker is amazingly versatile, as any specialist-group worker in the prime plants will realize if he checks with his contemporaries in other groups.

The pneumatics engineer probably will be astounded to learn that Whittaker manufactures some 6000 fuel or oil or other liquid gate valves each month and has turned out well over 1,500,000 such units since the company started, valves actuated either electrically, hydraulically or pneumatically and ranging in port size from one-half to four inches.

The company's production in this line represents literally hundreds of gate valve designs turned out by the Fuel Group now headed by Hank Waller who recently came to Whittaker from Republic Aviation.

All manner of fluids used in aircraft are handled by these valves and many of them are of distinct and unusual design — fire-resistant valves, either heat-shielded or submerged, together with several other submerged types: failsafe units which return to a pre-set position if for any reason control is interrupted, plug-in valves, valves that incorporate unique travel mechanisms, valves fitted into the smallest possible envelopes and units operating in the widest range of pressures, flows and cycles.

And fuel valve experts in the major plants no doubt will be surprised to learn the number of different products of Whittaker's Pneumatic Group directed by Jim Peck, units ranging from missile valves such as the new pressure regulator for reducing superhurricane helium in intercontinental missile systems through the entire gamut to conventional hot air shut-off valves.

In fact Whittaker hot air valves are used on virtually every engine and every air frame manufactured in America today and by many foreign manufacturers, too. With hundreds of types in production, the company is one of the major sources of hot-air equipment for aircraft and missiles.

In addition to various regulator valves, there are, among others, relief valves, ram air scoops, shut-off valves actuated pneumatically, electrically, hydraulically and manually; flow regulators, special light-weight shut-off valves that utilize air pressure in the line for actuation under solenoid control.

One unusual type in production by the pneumatics group is a unit containing a latching solenoid to assure that the valve will remain in the last position it was directed to by its controlling electronic signal when the signal is interrupted for any reason.

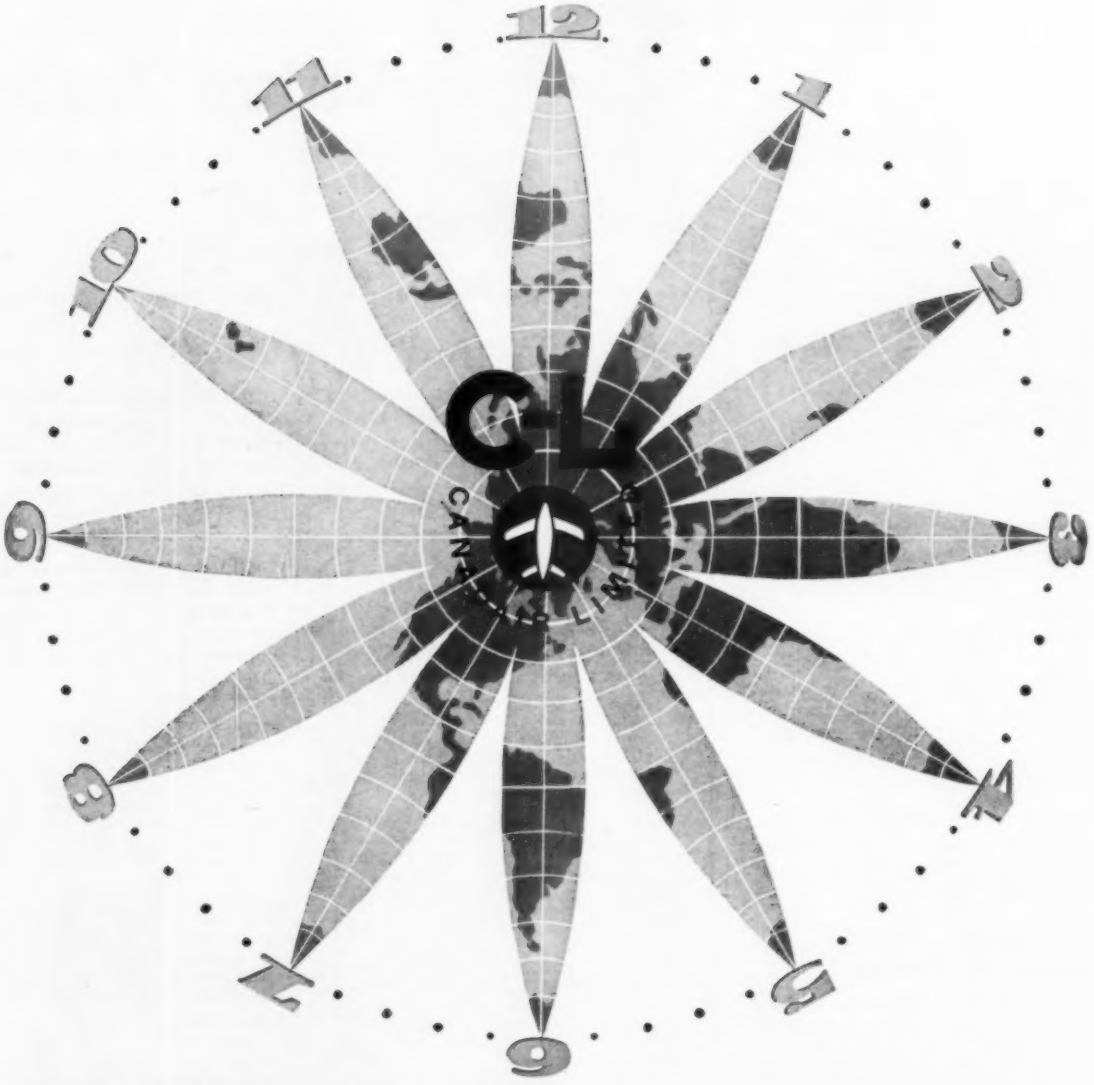
Another busy Whittaker section is the Hydraulics Group headed by Vic Larsen. Everything from the tiniest shut-off valves of standard type to large and complicated selector units is produced by Larsen and his crew.

Whittaker hydraulic units are principally noted for their shear seal type of construction, assuring low leakage and long service ("Shear seals don't wear out. They wear in!"). Typical production includes high-pressure and cartridge-type units and valves especially designed to handle high temperatures such as the new design that has been tested to 800 degrees. The group also designs actuators and relief valves, flow regulators, pressure regulators and related hydraulic equipment.

Nor do these three basic groups represent the extent of Whittaker versatility. The valve concern has developed many unusual special products, among them both flow joiners and flow dividers for fuel and oil and a series of high-efficiency fuel pumps now in production for several late-model aircraft.

With other outstanding new developments pending in this line, it appears inevitable that pumps will become a substantial portion of Whittaker's business within the next few years.

Thus you can readily see that Whittaker not only spells reliability, originality and efficiency. It also spells versatility!



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PASSENGERS and equipment thrown out of a gap ripped in the nose were run over by the aft end of the airplane. Most of the cabin area remained intact and many of the dead would have survived had their tie-downs held.

Air Crash Death or Injury May Be Prevented by Sound Detail Design

By Russell Hawkes

Death and severe injury can be prevented in any crash unless it is violent enough to disintegrate the cabin structure. Sound detail design in the cabin is the preventive.

The tacit assumption of the hopelessness of designing for crash survival gradually is being replaced by realization that the anatomy of man is rugged enough to withstand impacts greater than any which can be transmitted through the structure of a current airplane. The key to improving survival chances is in designing the tie-down of passengers and loose equipment up to the ultimate load factor of the airframe.

Foremost in the development of the new school of thought is Aviation Crash Injury Research of Cornell University. The philosophy of crash survival design adopted by Av-CIR divides causes of death and severe injury in survivable crashes into three general classifications:

• **Victim becomes** a "far-flung" missile. His tie-down to the airplane structure fails and he is hurled to the ground or against distant parts of the airplane.

• **Victim becomes** "near-flung" missile. His tie-down holds but his head, torso or legs are smashed against nearby lethal objects.

• **Victim is struck** by a missile. An object in the rear of the plane is torn from its tie-down and fired against his head or body.

In an actual crash, this division may be academic. The fatal results can be produced by a combination of causes. A 40-lb. object thrown against a seat back in a 10G crash will have an effective weight of 400 lb. The tie-down of the seat may be adequate for the weight of its occupant but fail under the additional 400 lbs., turning seat and occupant into a missile.

These in turn, may cause all the seats ahead to go down like a row of dominoes.

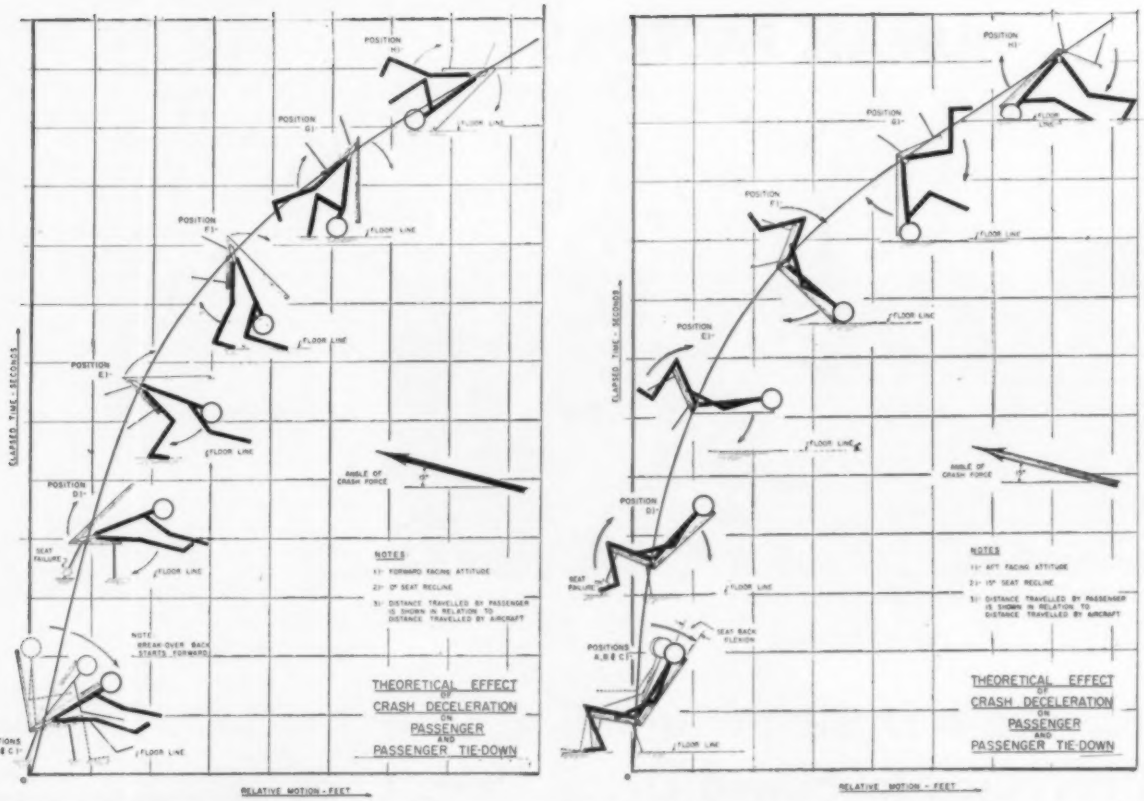
The basis for hope in crash survival design is in the relationship between the strength of the airplane and the strength of its occupants. Though airplane structure is stronger than the human body, it also is much heavier and usually subjected to many more pounds of decelerative force. A deceleration which is within human G tolerance will destroy an airplane. This fact was first suggested to Hugh DeHaven, founder of Av-CIR, by the numerous instances in which people survived falls from great heights without the benefit of a protective shell. Analysis indicated that the greatest survivable impact is higher than original estimates.

120G is Survivable

In one case a middle-aged woman leaped from a six-story building and fell 55 ft. landing on her left side and back, in the well-packed earth of a garden plot. After the fall she raised herself on one elbow and remarked, "Six stories and not hurt." Her body created a depression four inches deep. Her deceleration was estimated at 140G.

Statistical analysis of many such cases indicates that the body can withstand impact loads of 10 or 12 tons for periods of 1/200 to 1/10 sec. if spread over a large enough area of the

IMPORTANCE of good tie-down is emphasized by difference in damage done to seats at left which were torn free and with their occupants became "far-flung missiles," and those at right which were held in position.


POSITION H1
POSITION G1
POSITION F1
POSITION E1
POSITION D1
FLOOR LINE
ANGLE OF CRASH FORCE
SEAT FAILURE
NOTE BREAK-OVER BACK STARTS FORWARD
POSITIONS A, B & C
NOTES
1)- FORWARD FACING ATTITUDE
2)- 0° SEAT RECLINE
3)- DISTANCE TRAVELLED BY PASSENGER IS SHOWN IN RELATION TO DISTANCE TRAVELLED BY AIRCRAFT
THEORETICAL EFFECT OF CRASH DECELERATION ON PASSENGER AND PASSENGER TIE-DOWN
ELAPSED TIME - SECONDS
RELATIVE MOTION - FEET
POSITION H1
POSITION G1
POSITION F1
POSITION E1
POSITION D1
FLOOR LINE
ANGLE OF CRASH FORCE
SEAT FAILURE
SEAT BACK FLEXION
POSITIONS A, B & C
NOTES
1)- AFT FACING ATTITUDE
2)- 15° SEAT RECLINE
3)- DISTANCE TRAVELLED BY PASSENGER IS SHOWN IN RELATION TO DISTANCE TRAVELLED BY AIRCRAFT
THEORETICAL EFFECT OF CRASH DECELERATION ON PASSENGER AND PASSENGER TIE-DOWN
ELAPSED TIME - SECONDS
RELATIVE MOTION - FEET

AFT FACING PASSENGER has less chance than forward facing passenger if seat fails because head is foremost as he hurtles through cabin.

body. For the average male passenger this is a deceleration of about 120G.

Study of more than 1,900 air crashes in the past 14 years by Av-CIR investigators has shown that aircraft structure is unable to transmit impact at more than a fraction of this level. Regardless of the speed or angle of the initial impact, the progressive yielding and collapse of the part of the airplane between the passenger and the ground holds the G load upon the passenger down to the lower tolerance of the aircraft structure. If the deceleration is completed before the part of the structure surrounding him is swallowed in the impact, the passenger or crewman should survive. If the angle of impact is very steep or the airplane is inverted at the moment it strikes the ground, the chance of the structure remaining whole is diminished. The class of survivable crashes includes such accidents as short or long landings, aborted takeoffs and controlled emergency landings on reasonably open ground. Despite the fact that these are potentially survivable, they continue to account for a large percentage of fatalities.

The best approach to the class of non-survivable crashes is the continuing effort to reduce the accident rate. However, the fact that statistically it is 40 times safer to travel by air than by road has failed to attract a significant number of potential air travelers. The argument that any air crash is virtually certain death is largely responsible. A portion of truth in this can be seen from the fact that in the past 21 years, 1,530 people have been killed in crashes and 760 injured. In other means of transportation the proportion is approximately reversed. As the big jet transports raise passenger capacity toward the 200 mark it will be possible for the severe injury and fatality rate to rise even as the accident rate falls.

Crash Manual

People have continued to die and be severely injured in survivable crashes because engineers have generally been unaware of the correlation between certain common design features and crash incurred injuries. The principles of good crash survival design have been used piecemeal in different airplanes because of the insight of a few individuals. The first systematized exposition of these principles will be published by Aviation Crash Injury Research of Cornell University in the form of a Crash Survival Design Manual to be released this month. To obtain a copy write to Av-CIR, Marine Terminal, LaGuardia Airport, Flushing 71, N. Y. The manual is a loose-leaf book which will be kept up to date by the release of later research data as it becomes available. It will be divided into three sections containing design tip sheets, engineering data and technical papers on the subject.

Tie-Down Is Vital

A strong passenger tie-down is vitally important in crash survival design. It includes not only the seat belt and its attach points, but the seat structure, the attachments to the floor or sidewalls and the floor itself. As a chain is only as strong as it weakest link, so a 17G seat belt cannot protect the passenger against loads greater than 8G if 8G is the ultimate load factor of some other part of the tie-down chain.

The strength of the floor or fuselage structure to which the seats are attached determines the strength to which the passenger tie-down can be designed. A tie-down which is weaker than the attaching structure does not take advantage of the available margin of survivability. One that is much stronger than the structure will pay a weight penalty without improving the user's chances.

Seats that are attached to a strong floor at all points provide greater sur-

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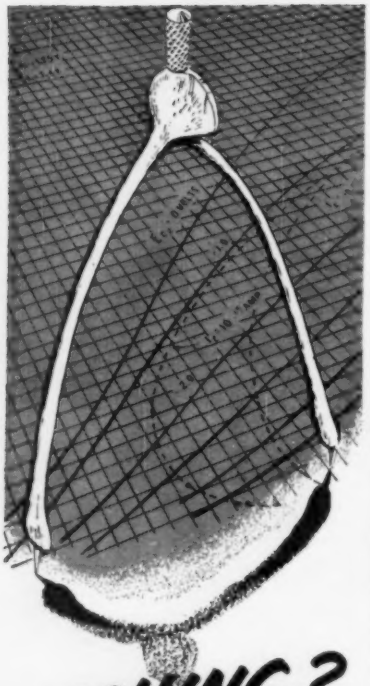

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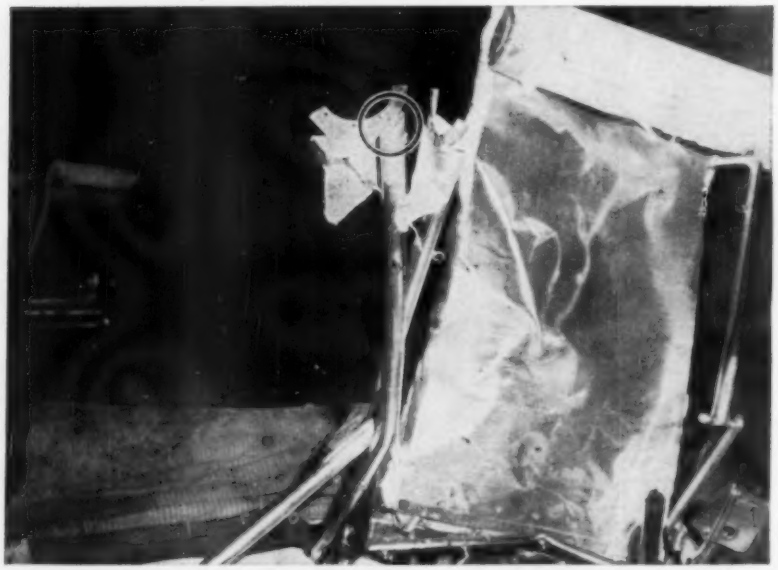
CENTER OF WEAK floor was buckled upward by supporting members when the bottom skin was driven in by impact against the earth. Note that the cabin was stripped of seats when the buckling floor broke rigid seat attachments.



A PASSENGER'S HEAD was punctured when his fall smashed the top of the seat baring the hard, sharp point of the side member which his head struck.

vivability than those which are attached to sidewall intercostals at the outboard ends. Under the force of the crash, the sidewalls and the floors are likely to weave in different directions at differing speeds and frequencies of vibration. This will cause the seat attachments to flex and perhaps fail. Also, the sidewalls may come into direct contact with obstacles on the ground and be peeled away. Passengers in floor-mounted seats would be more likely to survive this because the loss of the sidewall would not in itself be fatal. If the seat were attached to the sidewall, it would probably be snatched out of the airplane and hurled to the ground.

If the floor is much weaker than the sidewalls there is little advantage in using it as the sole attaching surface for the seats. In fact, it is probably desirable to free the floor of some of the crash load by using the side walls for a part of the attachment.

Which means of seat attachment is

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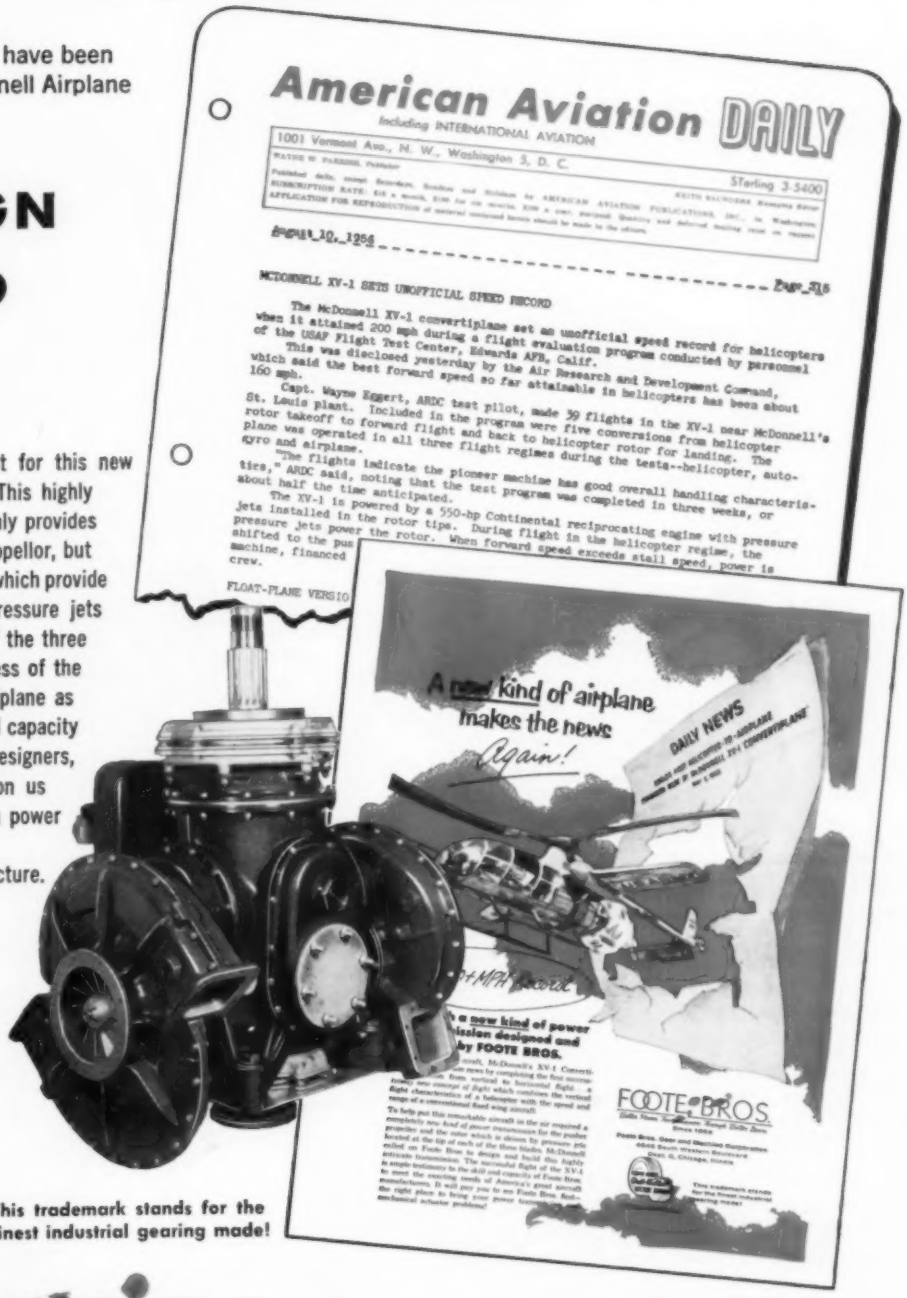
American Aviation DAILY
Including INTERNATIONAL AVIATION
1001 Vermont Ave., N. W., Washington 5, D. C.
Sterling 3-5400
August 10, 1956
MCDONNELL XV-1 SETS UNOFFICIAL SPEED RECORD
The McDonnell XV-1 convertiplane set an unofficial speed record for helicopters when it attained 200 mph during a flight evaluation program conducted by personnel of the USAF Flight Test Center, Edwards AFB, Calif.
This was disclosed yesterday by the Air Research and Development Command, which said the best forward speed so far attainable in helicopters has been about 160 mph.
Capt. Wayne Eggert, ARDC test pilot, made 39 flights in the XV-1 near McDonnell's St. Louis plant. Included in the program were five conversions from helicopter rotor takeoff to forward flight and back to helicopter rotor for landing. The plane was operated in all three flight regimes during the tests--helicopter, autogyro and airplane.
"The flights indicate the pioneer machine has good overall handling characteristics," ARDC said, noting that the test program was completed in three weeks, or about half the time anticipated.
The XV-1 is powered by a 550-hp Continental reciprocating engine with pressure jets installed in the rotor tips. During flight in the helicopter regime, the pressure jets power the rotor. When forward speed exceeds stall speed, power is shifted to the pus
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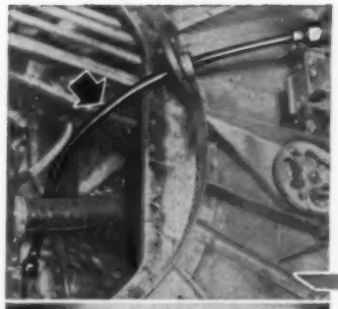
42 PASSENGERS were killed out of a total of 63 despite the fact that the floor and sidewalls remained fairly intact because seat attachments failed. Seat attachments had been tested at a higher load factor than the floor which remained smooth and intact but test load was static and crash loads are dynamic.

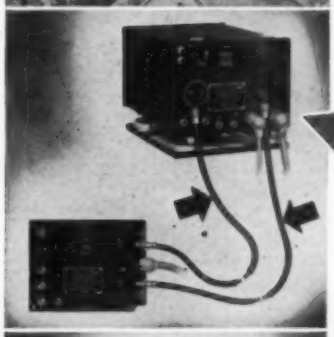
best depends on whether the designer views the floor only as a flat surface hung in the fuselage for the passengers to walk upon or as an integral part of the fuselage structure intended to bear part of the flight loads and provide extra torsional stiffness. Thin floors usually have vertical longitudinal members extending down to the bottom skin to provide necessary bearing strength. When the force of a relatively mild crash drives in the bottom, these members lift the middle of the thin floor, flexing and breaking seat attachments and possibly jamming passengers against the hatracks and ceiling.

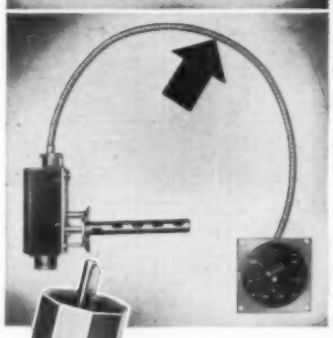
Examples of the strong floor singled out for special praise by A. Howard Hasbrock, director of Av-CIR, are those of the Curtis C-46, Martin 4-0-4 and Douglas's DC-6A and DC-7 series. The DC-8, Boeing 707, Convair 880 and Lockheed Electra all will have the strong floors recommended by Av-CIR. The floor surface of these airplanes is attached to frequently spaced transversals and a number of strong I-beams which run the length of the cabin.

The strong floor is not dependent upon the integrity of the fuselage bottom.

Av-CIR has on record cases in which the bottom has been wiped off DC-6As and the longitudinal I-beams provided sturdy sled runners on which the airplane coasted to a stop. With such a floor it is theoretically possible for the entire wing and fuselage structure to be destroyed in dissipating the kinetic energy of a crash and yet have the floor, seats and passengers left sit-







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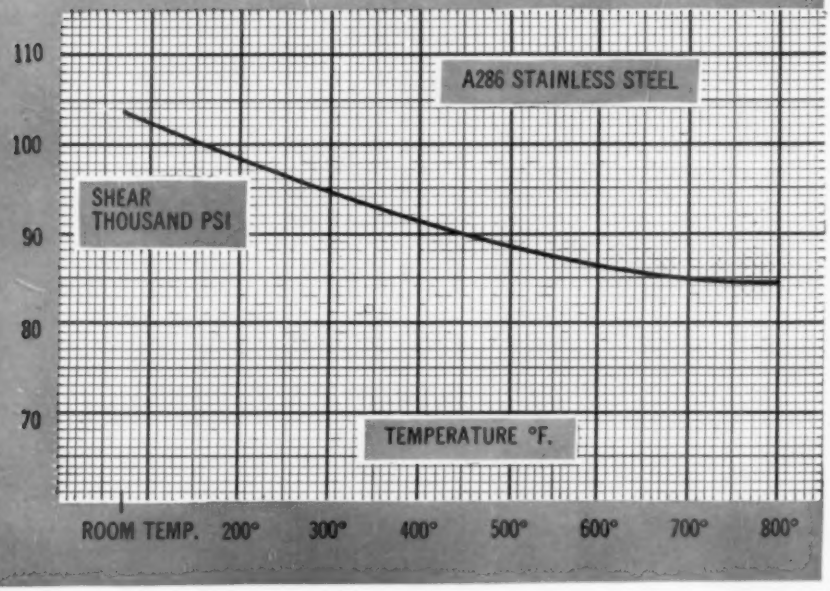

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ting alone and intact in the middle of a field.

Unrealistic testing procedures have sometimes made it impossible to capitalize on the advantages of the strong floor. In one crash in which 42 out of 63 passengers were killed, a genuine effort had been made to procure the maximum crashworthiness inherent in the airplane. The 42 deaths were caused by the failure of 20G seat attachments while the 12G floor remained intact. This inconsistency is ascribed to the fact that the 20G-plus-safety factor applied to the seat in tests was a static load while crash loads are dynamic.

It was one of many examples of a good try for crash survival design which failed to pay off because of the widespread lack of understanding of the nature of crashes. Tests applying well simulated crash loads to the entire tie-down chain would eliminate such miscalculations.

The way to prevent failure under dynamic loads is to design seats and attachments with greater pliability. One suggested design would attach the seat belt to flexible steel cables run through soft metal tubular seat structure to tie-down plates under the floor. This would provide a safe passenger tie-down even if the seat itself were to fail.

Another advantage of pliability is that it protects against the unpredictable side and downward loads which occur in a crash and destroy the resistance of a rigid seat to the continuing forward load. Computation of lateral loads should be based upon the fact that impact in survivable crashes is usually within 30 degrees to either side of head-on according to Av-CIR. Greatest angle below the longitudinal axis is 45 degress and greatest angle up is 15 degrees.

Pro-Forward Facing

In the aft vs. forward facing seat hassle, Av-CIR favors the latter and feels that the value of shoulder straps for passengers in airliners has been overrated. Av-CIR studies have shown that an ordinary seat belt can provide protection without hurting the wearer in decelerations up to 50G for the usual time periods of crash impacts. As this is a heavier load than can be borne by the aircraft structure, there is little point in quibbling about protection at higher levels.

The aft facing seat has certain faults which cut its value. The only major crash involving aft facing seats which Av-CIR has had a chance to investigate has resulted in fatal head injuries which took place when the seat attachments failed and the passengers became far-flung missiles. Early consideration of the data makes it appear that when

the seat attachments fail and the occupied seat tumbles down the length of the cabin, the head of the aft facing passenger is foremost and is smashed against debris and structure.

When a forward facing seat fails, the passenger first jackknifes over his seat belt placing his head close to the floor. When the attachments then fail, the aft ones go first and in the tumble the seat back is moved out in front of the occupant's body and provides some protection for his back. His thighs and the seatpan protect his chest.

Failure of the seat tie-down is considered more likely with aft facing seats or shoulder straps. When the occupant is held erect, the center of gravity of seat and occupant is several inches higher than when he is bent over a seat belt. Because of this, the moment arm on which the crash force is exerted is longer and the deceleration required to cause failure of the tie-down chain is less. If the CG with the passenger erect is half again as high as when he is jackknifed, then a floor capable of withstanding 12G with forward facing seats will only withstand 8G with aft facing seats.

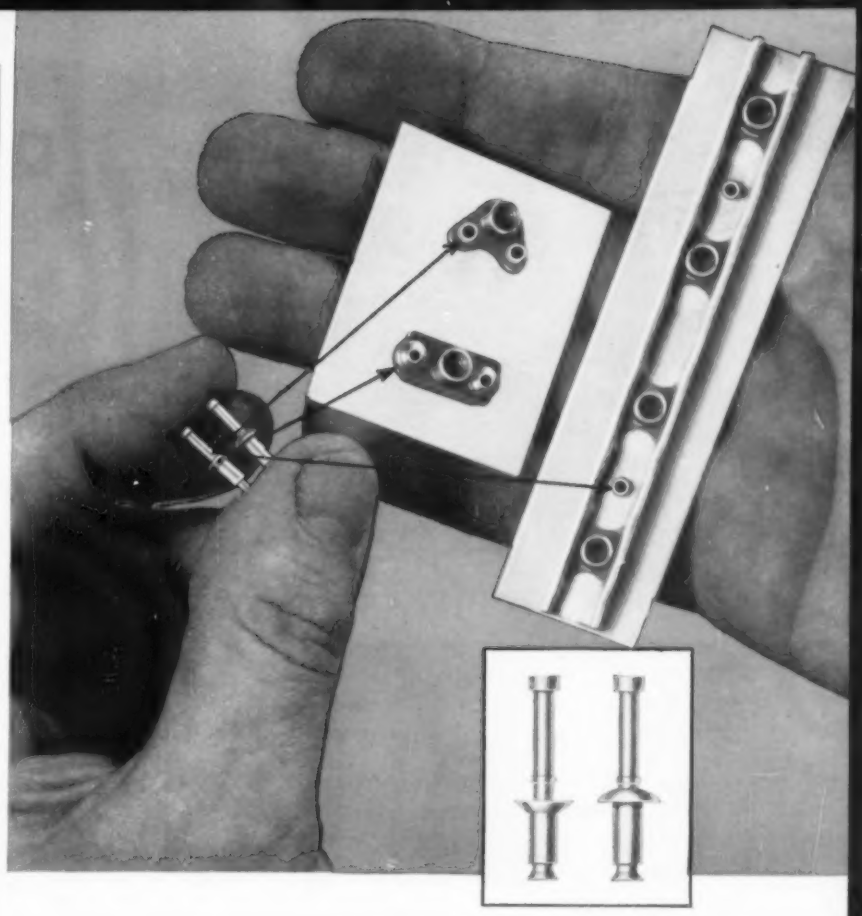
A British study of the relative merits of aft and forward facing seats reported strongly in favor of aft facing seats.

Hasbrook believes the report to be based on inconclusive evidence. No estimate of the deceleration forces was presented for crashes analyzed, and accident severity was judged on the basis of severity of crew injuries. Av-CIR has found no fixed relationship between the two.

The danger of drawing conclusions upon incomplete evidence is pointed up in a crash report by one group in which survival of all the passengers was attributed to aft facing seats. It was not reported that the forward facing pilots also were uninjured despite the fact that they had no shoulder harness and were seated in a cockpit full of lethal knobs and corners.

It is possible that as the speed and size of aircraft increases their structural strength may also increase to a point beyond the 50G safe limit of seat belts but this is not expected in the next 15 or 20 years. If it should happen, Av-CIR feels that aft facing seats would be desirable providing floors and tie-down chains are made strong enough to cope with the higher forces. They also are prepared to grant that a crash would be more comfortable in an aft facing seat assuming that the tie-down holds. However, a crash will never be a truly comfortable experience and Av-CIR feels that it is undesirable to purchase a margin of comfort at the cost of a margin of safety.

Assuming on adequate tie-down the



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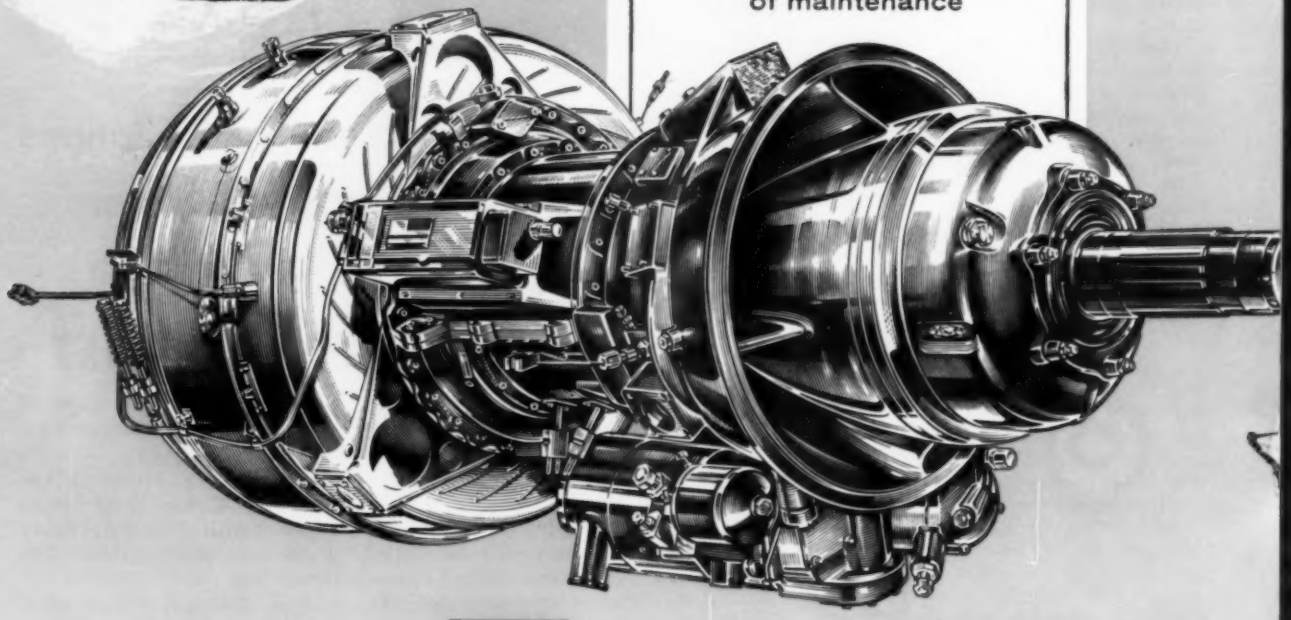

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Developed under the sponsorship of the U. S. Army and the U. S. Air Force, the T-53 has already been selected to power the Army's newest Utility 'Copter (Bell XH40). Bell and Kaman have received their flight test engines. Even now the T-53 is being installed in boats, and stationary power plants are under consideration. Yet it is in the field of turbo-prop applications that the T-53 might very well offer its most exciting possibilities.

Ready to take to the air, the complete turbo-prop weighs only 460 lbs. and delivers 960 h.p. from a compact 47.6 length x 23-in. diameter. Using a variety of fuels including automotive and aviation types, gasoline and JP-4, it operates at a low 0.655 lbs. per e.s.h.p. per hr. consumption. Rugged design features and unprecedented ease of maintenance guarantee safe operation and long life.

In addition to its weight advantage as a turbo-prop, the Lycoming T-53 could be made available with front-end or rear-end power take-off or simultaneous power extraction at both ends.

There can be no doubt that the T-53 will set new standards for small aircraft. Developed by the men who built the first mass-produced jet engine to fly, Lycoming's T-53 may solve the turbo-prop problems you're facing *right now!*

To learn more about the T-53 and Lycoming's ample facilities to produce it, phone, wire or write for turbine information to Avco Lycoming, Stratford, Conn.

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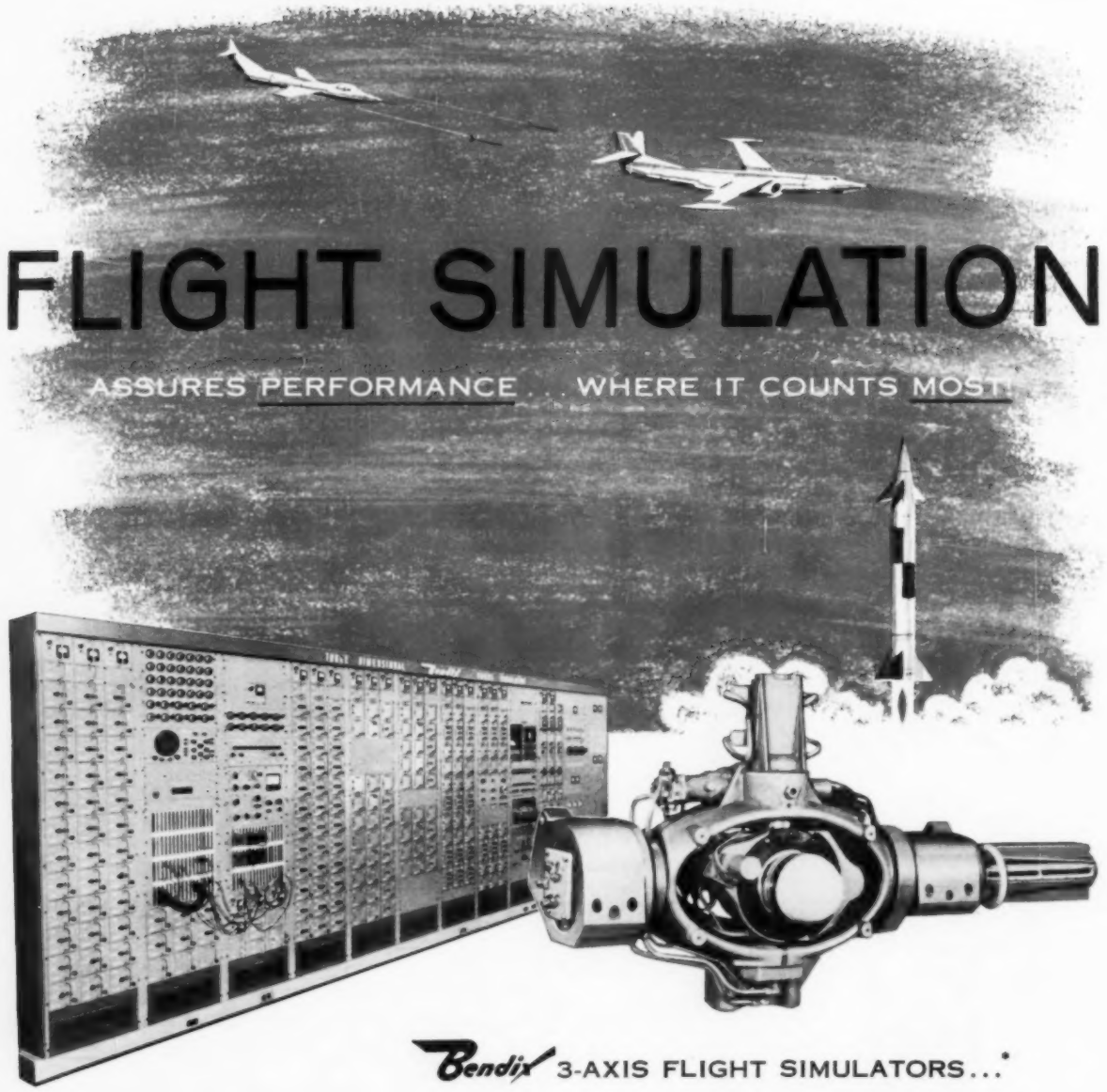

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greatest danger to a forward facing rider involved in a crash is that he may become a near-flung missile. Head, torso and leg injuries produced by flailing against hard or sharp objects are among the most common causes of death in crashes. While broken legs are seldom directly responsible for death, they prevent the victim from getting away from the airplane before he is killed by fire or fumes.

Head Injury Prevention

Prevention of injuries to the head requires particularly careful design of window sills, seat-backs, hatracks and armrests. The skull is a stressed skin structure like an egg shell. It can take considerable loads spread evenly over its surface but once its integrity is broken by a blow from a small object which concentrates stresses in a small area, its ability to resist stresses at any point on its surface is much reduced.

Designing a seat-back is more than a matter of providing something which will be comfortable to its occupant. A comfortable seat was responsible for the deaths of 22 people in a crash recently investigated by Av-CIR. The cabin remained virtually intact but 11 victims had big holes punched in the middle of their foreheads. The top of the seat-back was made of a padded soft metal head roll riveted to vertical tubular steel side supports which were rigidly attached to the rest of the seat structure.

The tops of the steel verticals were beveled to points adjacent to the ends of the head roll to fit the stylish shape of the seat-back.

The plane hit the ground in a slight yaw causing the passengers to jackknife forward and to the left over their seat belts. The sideward swing caused their right shoulders to hit the headrolls of the seats in front and knock them from between the verticals. Their heads hit the sharp ended tubes which broke their skulls and penetrated their brains.

Safe Seat-Back Design

The lethal potential of seat-backs can be eliminated by allowing them to fold forward over the jackknifed occupant and by avoiding hard projections and rigid structure. The ductile sheet metal seats designed and used by Convair are cited by Av-CIR as an example of safe design in this respect. Soft metal will leave sizable bruises but by yielding will spread the impact over a wider area, cutting down the danger of a fracture and by spreading the deceleration over a distance of several inches, will reduce the likelihood of severe concussion.

Projections such as screw heads are covered with stiff padding to prevent them from poking holes in the skulls

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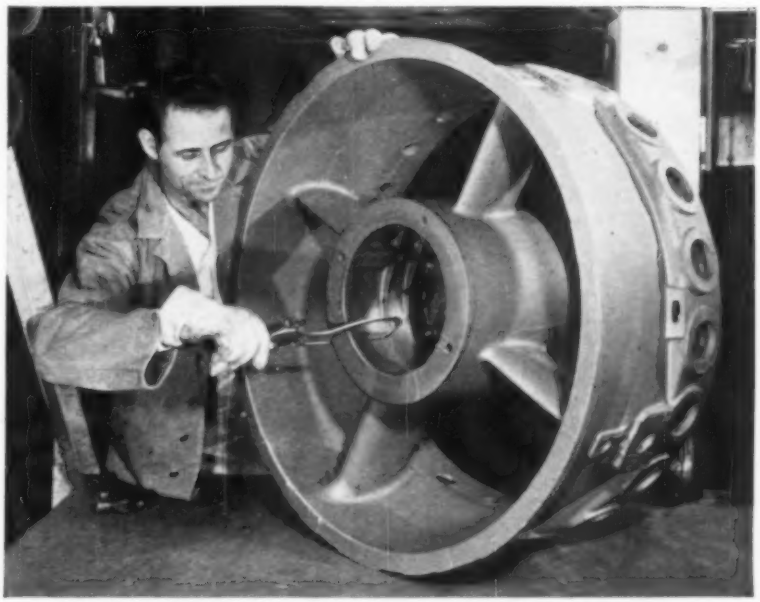

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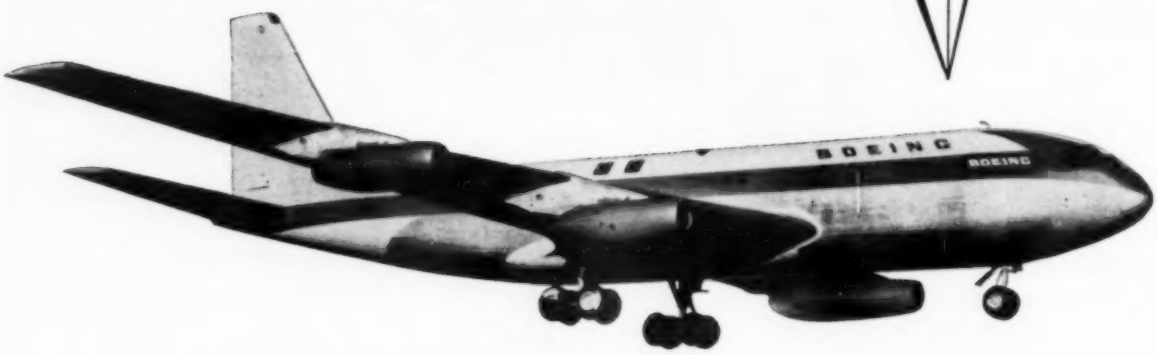

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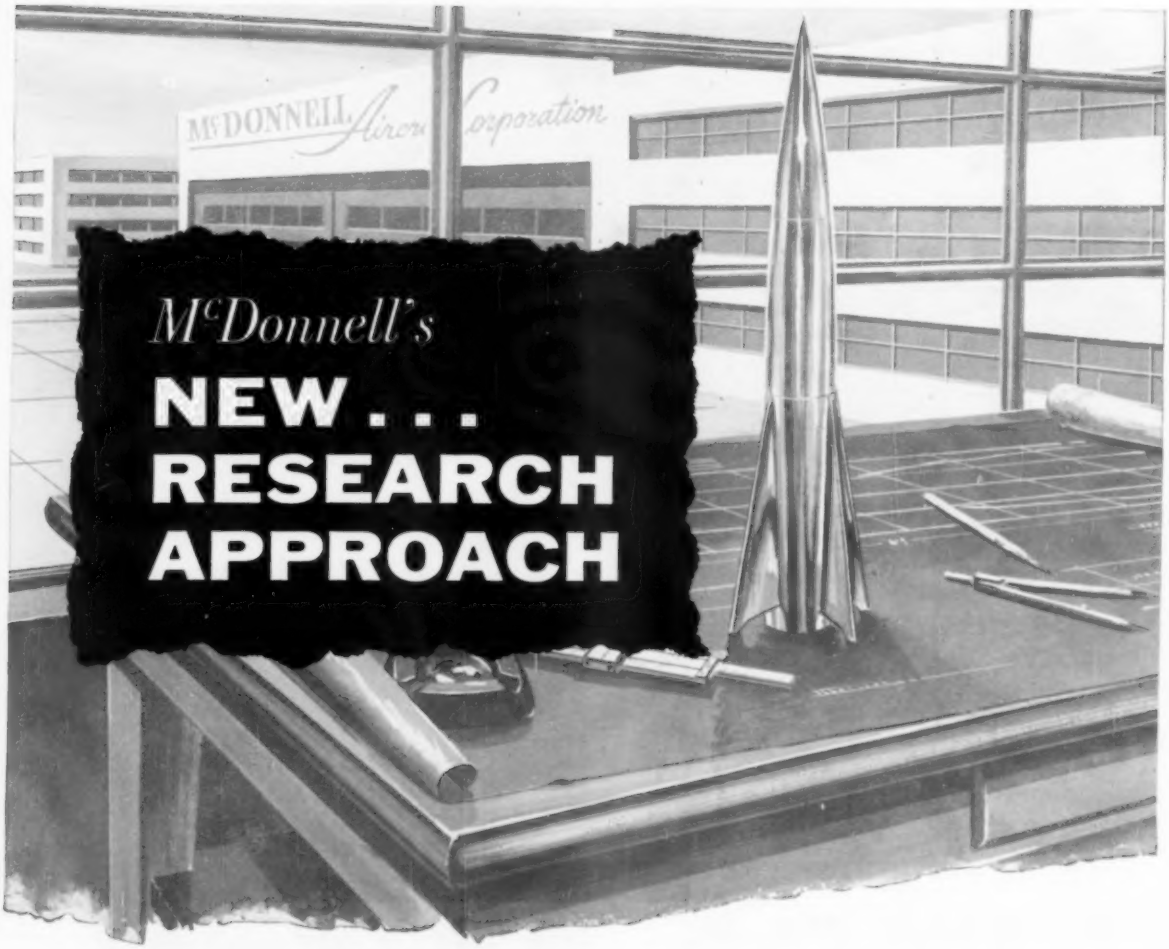

McDonnell Aircraft Corporation has recently organized a new Research Department which will be directed by Dr. Albert E. Lombard, Jr. By this action our management has again evidenced its determination that McDonnell shall maintain its position of leadership in the development of advanced aircraft and weapon systems in future years.

This highly talented research group will be concerned with problems of scientific research directed towards specific objectives in the field of transonic, supersonic and hypersonic aerodynamics, aircraft materials and structures, guidance, control and dynamics of flight, unconventional take-offs and landings, unconventional propulsion, high temperature phenomena and high altitude phenomena, radio propagation and antennas. Additional efforts in the area of systems research will be directed towards conceiving and evaluating the feasibility of new advanced aircraft and weapon systems, establishing time scales for their accomplishment, estimates of probable markets and defining the requirements for additional research done by or sponsored by McDonnell.

Engineers and scientists with advanced education and experience in defining, executing or overseeing research projects related to aircraft, are invited to investigate career opportunities as a member of our new research staff. Write in confidence, including a detailed experience resume to:

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of passengers. Familiar soft foam rubber would be next to useless because when fully compressed, a dangerous hard lump would protrude.

Belts, Shoulder Harness

The danger of becoming a near-flung missile is especially great for the crew because of the multitude of lethal control knobs and instruments surrounding them. Av-CIR is following two approaches to alleviate these dangers. One is to mount instruments and control banks on shear pins designed to fail under the G-loads encountered in a crash. This would allow impact to catapult them forward into the nose of the airplane and away from the pilots. Sharp edged window sills have accounted for the life of more than one pilot. Av-CIR says these can be designed without edges or corners and the hard parts can be padded.

The second and simpler approach would be to provide the crew with strong shoulder straps and a seat and floor structure strong enough to bear the weight of an erect body. Shoulder straps which have been available in the past have been disliked because when locked and tight the pilots were held out of reach of some controls. The attachments of earlier shoulder straps have also been weaker than the seat belts with which they were used, thus missing much of their potential value.

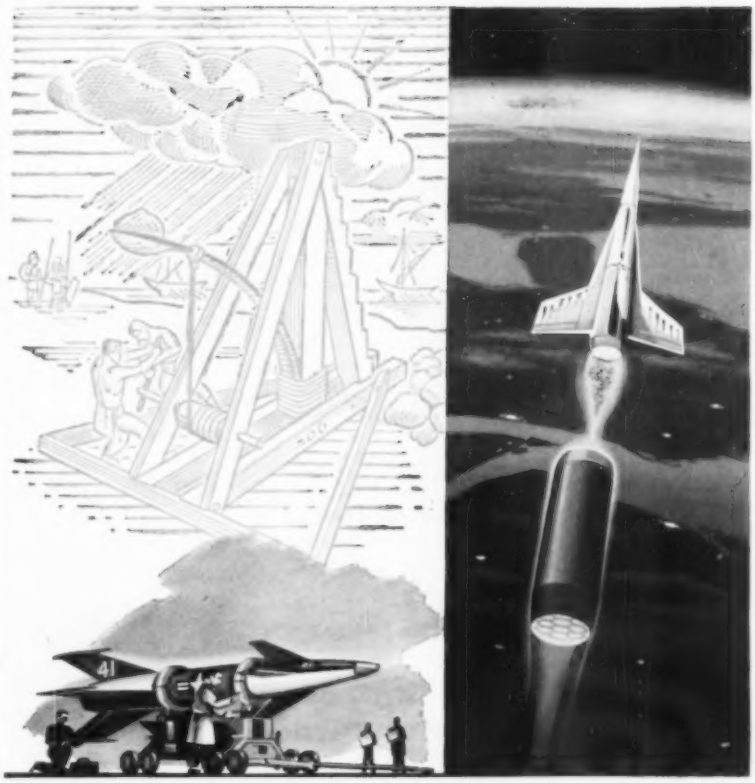
The percentage of seat belt failures, while small, can be reduced. The buckle of the military type seat belt had a long release lever which could be caught and released accidentally by a shirt cuff. Standard passenger seat belts have been known to open on impact.

Av-CIR believes that the free strap end is sometimes swung forward against the friction lock lever with enough force to open it.

Av-CIR has designed and Aerotherm is producing a seat belt shoulder harness combination for the pilots which appears promising. The seat belt has a metal-to-metal mechanical latch which has no protruding lever and cannot be opened by the force of impact. The shoulder straps buckle on to the seat-pan and are connected to a steel cable on a spring loaded reel which allows the pilot to lean forward and reach any control in the cockpit. An inertia switch automatically locks the shoulder harness on impact.

Struck By Missiles

The third cause of death, being struck by a flying missile, is probably the easiest to prevent. Crash investigators continually find hand fire extinguishers, carry-on luggage, and galley equipment up in the cockpit. In one quite minor crash, a blood-stained 20-lb. casserole box was found on the



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Italian Air Force F-86K

Fiat-Built F-86K in service with the Italian Air Force drags its tail chute in a landing during operational exercises. Plane duplicates North American F-86D Sabre with exception of armament system. Plane has four 20-mm. cannon, and an earlier fire-control system than current F-86Ds in service in the United States. An Italian Air Force F-86K is serviced during operations (below).

floor between the pilots' seats. Evidence indicated that it had struck many seats and passengers in its flight. Injuries caused by this sort of thing can be prevented by designing the mounts for such equipment to the same load factors planned for the seat tie-downs.

This is done with equipment mounted in radio racks and it is almost always found in its proper place after a survivable crash.

Future Modifications

Some factors of crashworthy design which require changes that are too extensive to be retrofitted to current aircraft may appear in the next design generation. Av-CIR is uneasy about high-wing, multi-engined designs with the landing gear mounted in the nacelles and the passengers forward of the wing spars. Over 50% of the gross weight of a multi-engined plane is in the wing and nacelles. In a crash, the momentum of this weight can only be absorbed by the collapse of everything ahead of and below the wing spars.

A more favorable view is taken of high wing multi-engined designs with fuselage mounted landing gear, such as the Fairchild C-123, Lockheed C-130 and Douglas C-133. In this configuration the sidewalls must be built strongly enough to bear landing loads plus a safety factor. Structure that rugged is not likely to fail in any survivable crash.

The point in its length at which a wing is most likely to break in a crash is important from the standpoint of crash survival design because all or most of the highly combustible fuel is stored there. While little was known about crash survival design at the time of its conception the Convair Liner has an extremely crashworthy wing.

Breaks Inboard

It breaks inboard of the fuel storage areas and far enough out so that no part of the fuselage is torn away. Some passenger airplanes have wings so strong from end to end that instead of breaking they are ripped whole from the fuselage, taking the front end of the cabin floor with them. When these types crash, passengers who become far-flung missiles often fall through the hole and are run over by the aft end of the airplane.

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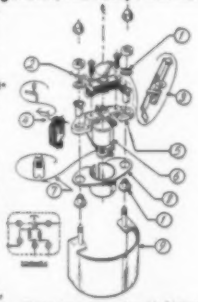

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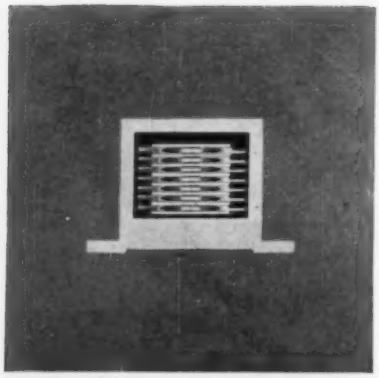

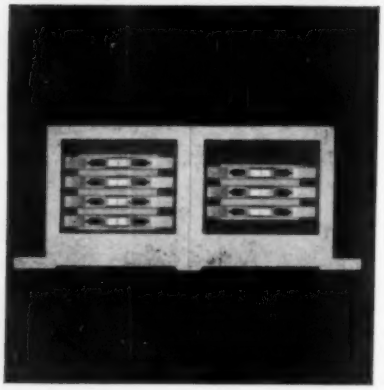

SINGLE STACK versus INTERLEAVED HEADS

for magnetic tape DATA recording

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The original single track recording head left little room for choice or controversy. But as tracks multiplied, and the heads were stacked, troubles developed. More tracks per inch required thinner heads and closer head spacing. But closer head spacing in analog recording increased the intertrack crosstalk. Wider intertrack shielding had to be used, thereby defeating the original need.

Interleaved heads seemed to be the answer. The tracks per head were halved by alternating them on two heads, and mounting the heads side-by-side. Crosstalk became less important for there was no longer a tight limit on shielding width.

Interleaved heads performed handsomely until applied to really precise data work. In aircraft and missile testing, for example, the wave shape on one track is often important only as it relates to wave shapes on other tracks. Unfortunately, time and phase coincidence among tracks is the one thing that interleaved tracks on two heads *can not* provide. By recording a given number of tracks with a single stack head on wider tape, far less phase error is experienced than with interleaved tracks on narrow tape. Thus the pendulum has swung back toward single stack heads, with the proviso that individual heads in the stack be precisely aligned. Typical specifications require that all gaps lie between two straight lines 0.0002" apart, assuring less than 0.2 mil total scatter.

On the basis of proved operating characteristics, these guides have been found extremely useful in finding the right head for a given application:

USE SINGLE STACK HEADS WHEN *time and phase coincidence among tracks are at all important, for in such work precisely aligned single stack heads are absolutely essential. Even when track-jamming is necessary, modern intertrack shielding in a well designed system can reduce crosstalk to a minimum factor.*

USE INTERLEAVED HEADS WHEN *it is essential that a very large number of tracks must be recorded, and considerable time and phase displacement among them can be tolerated, or when compatibility with other equipment using interleaved heads is necessary.*

In digital recording there never has been any controversy. For one thing, crosstalk is not so much of a problem. For another, time and phase coincidence have always been of the utmost importance. If interleaved tracks in two separate heads are used, even the slightest tape stretch or shrinkage between recording and playback completely destroys coincidence of pulses across the tape.

Whichever side of the fence you're on, you're sure to find considerable use for the detailed coverage of the entire head situation given in Bulletin 3301, "Multi-Track Record/Reproduce Heads." Write Davies for your copy.

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Reports Available

Following is a list of reports with their order numbers available from OTS, U. S. Department of Commerce, Washington 25, D. C.:

• **Refractory Materials for Use in High Temperature Areas of Aircraft** (PB 121046)—by N. R. Thielke—Prepared by Pennsylvania State University for Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $2.50; 97pp.

Studies of carbide cermet and oxide-type ceramic bodies and an investigation of thermal shock are described in this report of Air Force-sponsored research into high temperature-resistant materials.

• **Space Requirements of the Seated Operator** (PB 121053)—by W. T. Dempster—Prepared by University of Michigan for Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $3.50; 271pp.

This report studies the geometrical, kinematic, and mechanical features of the male physique with particular reference to the limbs, and presents material essential for synthesizing realistic manikins, understanding body kinematics of the seated operator (pilot) in his work space (cockpit), and defining work-space dimensions.

• **Aerodynamic Heating and Heat Transfer for Airfoils at Mach Numbers of 2.74 through 5.7** (PB 121045)—by A. E. Abramson, W. L. Torgeson and J. A. Zdrazil—Prepared by Research, Inc. for Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $4.00; 156pp.

The report presents the results of theoretical and experimental investigation into recovery factors and heat transfer coefficients for three basic airfoils from Mach 2.74 to 5.7.

• **Office of Naval Research High Temperature Project, Final Report** (PB 121024)—by J. B. Conway and A. V. Grosse—Available from OTS, U. S. Department of Commerce, Washington 25, D. C. $1.75; 65pp.

The results of five years of research into new methods for production and maintenance of extremely high temperatures in special furnaces are summarized in this report.

• **The Human Pilot** (PB—121073)—Prepared by Northrop Aircraft, Inc., for the Bureau of Aeronautics, Navy Department, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $4.25; 166pp.

This volume is a codification of the material in the field, intended to provide systems engineers with a basic knowledge of aspects of dynamic human responses directly relevant to the design of aircraft control systems.

• **The Inadequacy of Visual Search in Avoiding Mid-Air Collisions** (PB 121130)—by G. O. Emerson, R. D. Metcalf and H. C. Glover—Prepared by Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $.50; 11pp.

This report studies the problem of the inadequacy of visual search in terms of monocular and binocular blind areas produced by aircraft structural members, and comparative danger from various azimuthal positions.

• **Three-Dimensional Flow in Axial-flow Turbomachinery** (PB 121052)—by L. H. Smith Jr.—Prepared by Johns Hopkins University for the Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $3.50; 140pp.

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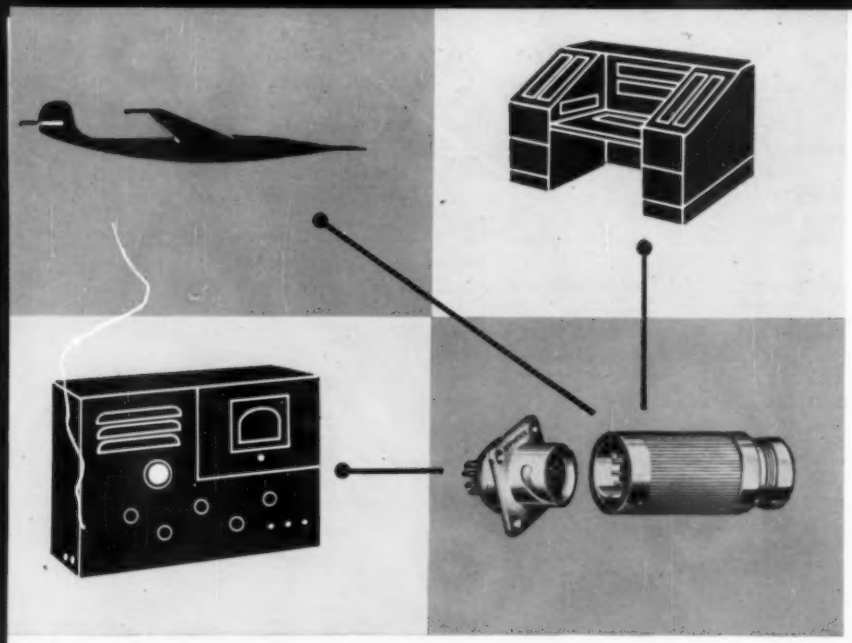

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principal effects of secondary flow can be included in the design of multistage axial-flow turbomachinery, and a mechanism designed to test this method are described in this report.

• **A Design Manual for Thermal Anti-Icing Systems** (PB 121135)—Prepared by Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $5.50; 302pp.

Partial contents of the report are methods and reference material for the design of steady-state (continuous) anti-icing systems utilizing as the heating medium, hot air floating along inner surfaces of the skin through so-called double-skin heat exchangers.

• **Engineering Study of Air Conditioning Load Requirements for Aircraft Compartments** (PB 121139)—by W. L. Torgeson, H. C. Johnson, and N. B. Wright, Jr.—Prepared by Research, Inc. for Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $4.50; 177pp.

Including methods of analysis, graphs, procedure outlines, and sample problems, the report discusses and illustrates information needed for computation of heating and cooling loads for aircraft compartments.

Ramp Radio

This shoulder strap type walkie-talkie radio, used by a United Air Lines' ramp supervisor, helps to expedite aircraft ramp movements at UAL's stop at Honolulu. Supervisor can use the Motorola set to talk with the operations office, hangars, and crew members taxiing the aircraft.

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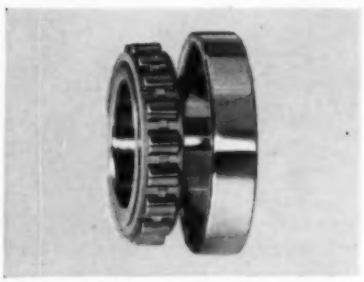

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B6

Discovery May Triple UHF-VHF Range

By Philip J. Klass

Utica, N. Y.—The discovery of new tropospheric scatter phenomena has opened the possibility of extending the reliable range of UHF-VHF voice communications between aircraft and ground stations several hundred miles beyond present line of sight limits. The discovery verges on a technological breakthrough in air-ground communications.

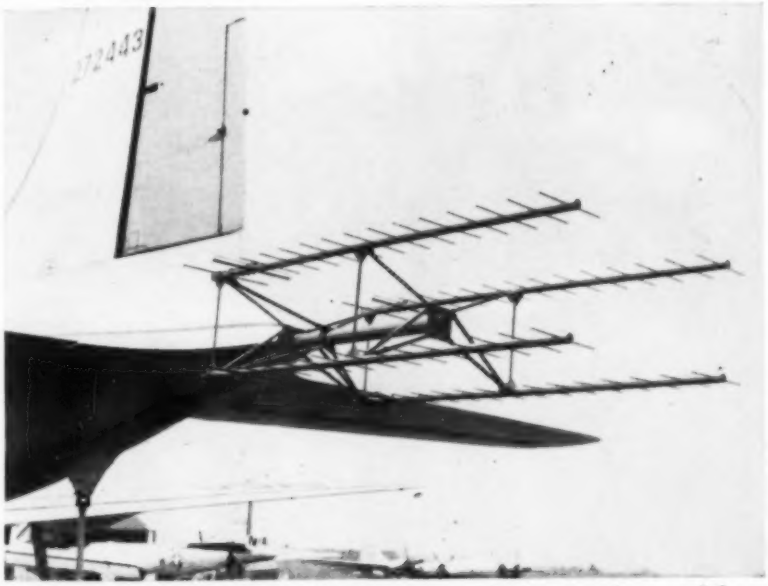
First public disclosure of the new scatter propagation data was made by Thomas F. Rogers, chief of the Air Force Cambridge Research Center's Communications Laboratory in a paper delivered here during the recent Aeronautical Communications Symposium. The paper was co-authored by L. A. Ames and Lt. E. J. Martin, both of AFCRC.

Although tropospheric scatter has made it possible to extend the range of UHF voice communications beyond the radio horizon in point-to-point applications (between two ground stations), its use for air-ground communications previously appeared to be completely out of the question. It was not known whether scatter fields even existed at altitude, and besides, large antennas and high power transmitters were needed to blast through the line-of-sight barrier.

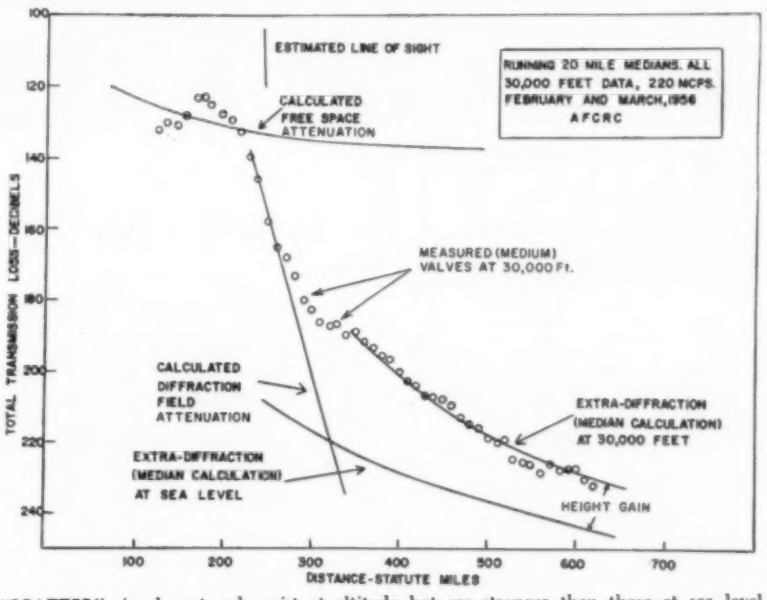
However, AFCRC's tests have now firmly established the existence of scatter, or "extra-diffraction" fields far above the ground, Rogers reported. Even more significant, AFCRC discovered that scatter field strength actually increases with altitude. This eases the overall system power required and unlocks the door to air-ground scatter communications.

Rogers reported that a specially outfitted B-29 flying at 29,000 ft. consistently received signals from a 500 kw. (peak power) experimental radar at distances up to 600 mi., nearly 400 mi. beyond line-of-sight range at that altitude. In other voice tests, a special frequency modulation speech transmission from a commercial television station was received at distances beyond 400 mi. at altitudes up to 30,000 ft.

However, Rogers cautioned "that no simple modification of present air-ground equipment can reasonably be expected to provide consistent coverage to these distances. The same order of system improvement (over present line of sight equipment)—some 60 to 80 db. —must be achieved, as was required for the successful exploitation of scatter propagation for ground point-to-point."



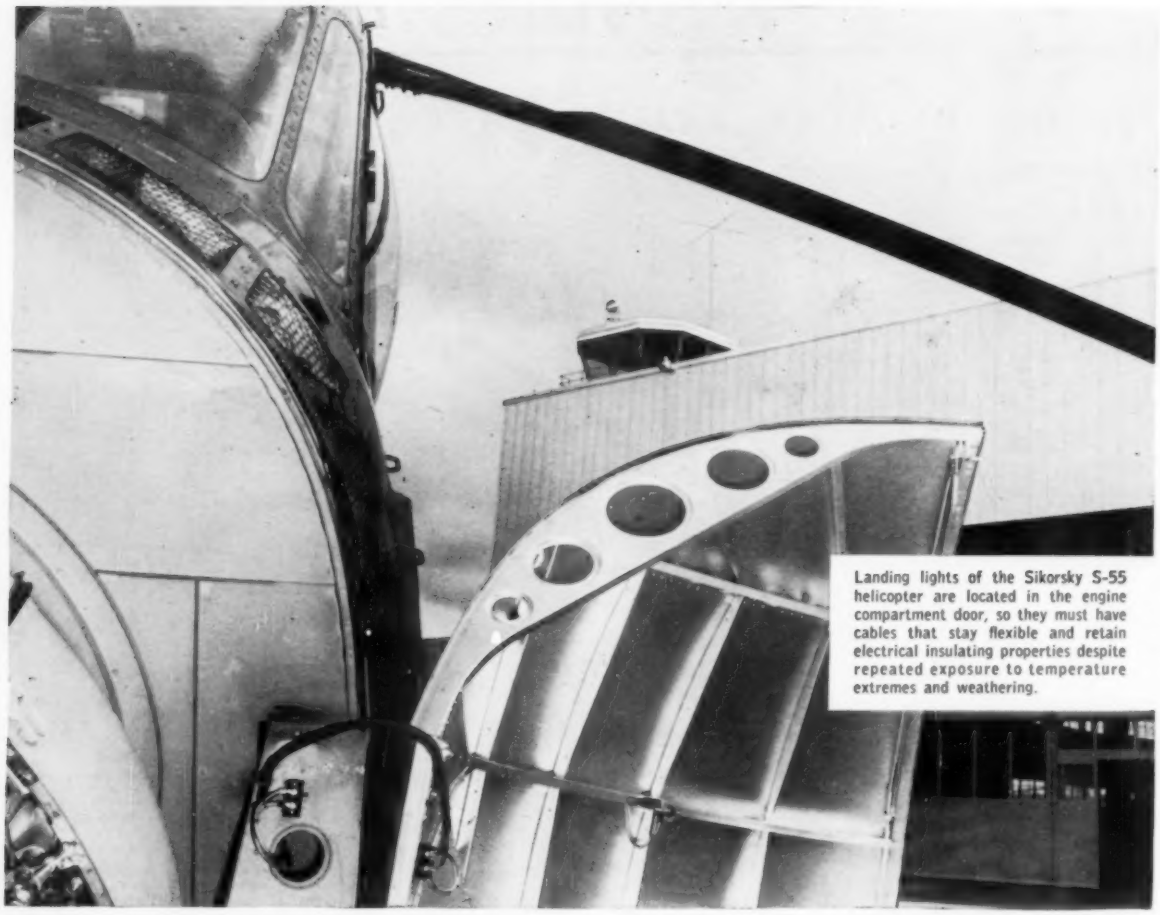
USAF tests, using C-54, B-29 equipped with experimental Yagi antenna, have revealed . . .



"SCATTER" signals not only exist at altitude but are stronger than those at sea level.

AFCRC conducted its airborne scatter propagation tests at frequencies of around 220 mc. inasmuch as USAF-Navy air-ground communications operate in this UHF band (225 to 400 mc.) However, Rogers told AVIATION WEEK that the same techniques are applicable to the civil-airline VHF communications band. In fact, it should be slightly easier to obtain reliable scatter communications because at lower frequencies the antenna is more effective in absorbing radio waves.

Every increase in aircraft speed has the effect of shrinking the effective range of VHF-UHF communications



Landing lights of the Sikorsky S-55 helicopter are located in the engine compartment door, so they must have cables that stay flexible and retain electrical insulating properties despite repeated exposure to temperature extremes and weathering.

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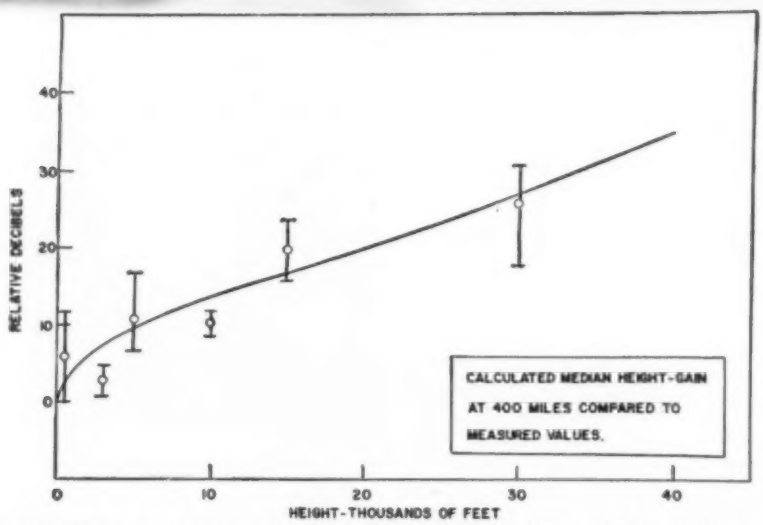
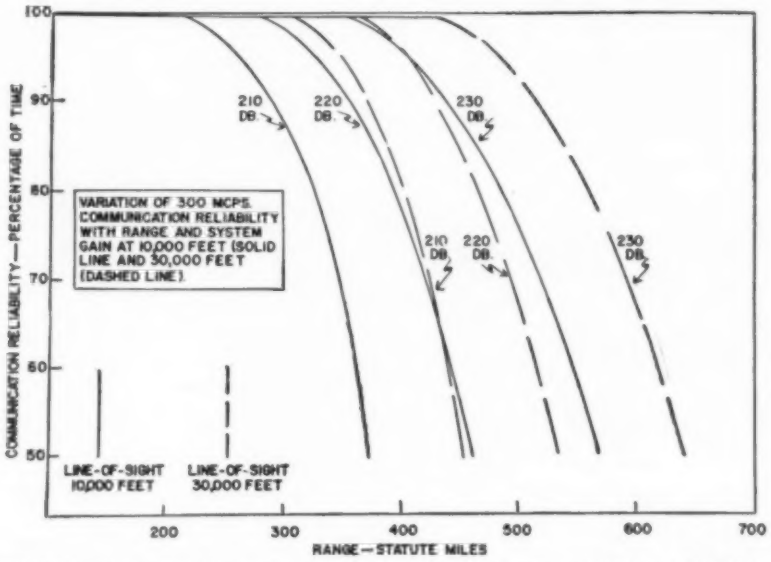


INCREASED scatter signal strength as function of altitude at distance of 400 mi., showing range of measured values (vertical "I") and calculated median value.


COMMUNICATION RELIABILITY—PERCENTAGE OF TIME
RANGE—STATUTE MILES
210 DB
220 DB
230 DB
VARIATION OF 300 MCPS COMMUNICATION RELIABILITY WITH RANGE AND SYSTEM GAIN AT 10,000 FEET (SOLID LINE AND 30,000 FEET (DASHED LINE).
LINE-OF-SIGHT 10,000 FEET
LINE-OF-SIGHT 30,000 FEET

RELIABILITY of ground-air scatter communications with aircraft at 10,000 and 30,000 ft. which can be expected at various distances as a function of overall system gain.

in terms of flying time—despite the fact that aircraft are operating at increasing altitudes where line-of-sight range is greater.

For example, a DC-3 flying at 12,000 ft. can contact a VHF ground station when it is one hour out, whereas a jetliner flying at 40,000 ft. cannot reach the station until it is about 30 minutes away. For some of the new jet fighters, this interval is slashed to 15 minutes or less.

The only obvious alternative is to shift more air-ground communications from VHF-UHF to the already crowded HF band which is not limited to line-of-sight ranges. However, HF is far more susceptible to noise, interference, and occasional black-outs from atmospheric and Auroral disturbances. HF communications is particularly vulnerable to Auroral black-outs in the far north and over the North Atlantic.

The application of tropospheric scatter techniques may get air-ground communications off the horns of this dilemma. VHF-UHF is not vulnerable Auroral disturbances. If its range can be extended to 400-500 mi., a few strategically located ground stations, linked by point-to-point scatter communications, might be able to provide a reliable substitute for present HF service.

Although Rogers declines to speculate about the application of ground-air tropospheric scatter techniques to navigation aids, such as VOR, this

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would appear to be another valuable application for service in the far north and over the North Atlantic.

UHF Propagation

Free space attenuation of VHF-UHF radio energy in the line-of-sight region is relatively moderate. At a frequency of 300 mc., this free space attenuation between two omnidirectional (gain-less) antennas is about 106 db. at 10 mi., increasing by approximately 6 db. for each doubling of distance. For example, attenuation is 112 db. at 20 mi., 126 db. at 100 mi.

But as the distance approaches the "radio horizon" (where the curvature of the earth comes between the transmitter and receiver), the attenuation begins to increase more sharply. For example, at 300 mc. a signal suffers 24 db. more attenuation near the radio horizon than would be expected from the free-space attenuation figures, Rogers said.

Beyond the radio horizon, in what is called the "diffraction region," signal strength falls off sharply at a rate of nearly 1 db. per mile. This means that system performance must be increased by a factor of 10 for every 10-mi. increase in range.

Until several years ago it was believed that this sharp signal attenuation continued indefinitely. Then scientists discovered that if they could blast through the initial diffraction region, the radio signal would no longer be attenuated at so steep a rate. Although the attenuation in this "extra-diffraction region" is greater than that of free space, it is considerably more moderate than that in the diffraction region. This discovery opened the way to tropospheric scatter communications for point-to-point use but required high power transmitters, large (high gain) antennas, and extremely sensitive radio receivers.

Accelerometer

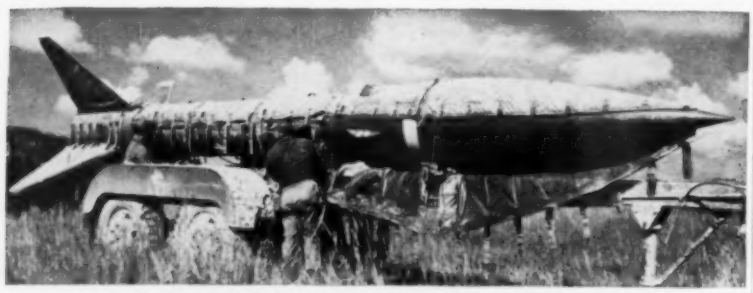
Super-sensitive accelerometer, developed by Northrop Aircraft for inertial guidance, employs construction similar to balance mechanism of human inner ear. Device consists of two glass tubes, each with tungsten electrode, joined together by two smaller tubes and filled with electrolytic. Acceleration causes displacement of electrolytic, changing accelerometer output signal.

Height Gain

For the past three years AFCRC has been running tests, using a C-54 and B-29, to make airborne measurements of tropospheric field strength. (Rogers calls them the first airborne measurement of tropospheric scatter field strengths to be made beyond 200 mi. at frequencies above 50 mc.) From these tests AFCRC has discovered two significant things that open the way to ground-air scatter communications:

- **Scatter propagation** is *not* solely a surface phenomenon. Scatter fields have been observed to be of the same fundamental character throughout the range of altitudes measured to date—500 to 30,000 ft. and out to at least 600 mi.
- **Scatter signal level** increases with altitude. For example, at 30,000 ft. scatter signal strength will average about 25 db. above the scatter signal level on the ground. (However, the rate of signal strength with distance from the transmitter increases with altitude.)

Rogers also reported the following



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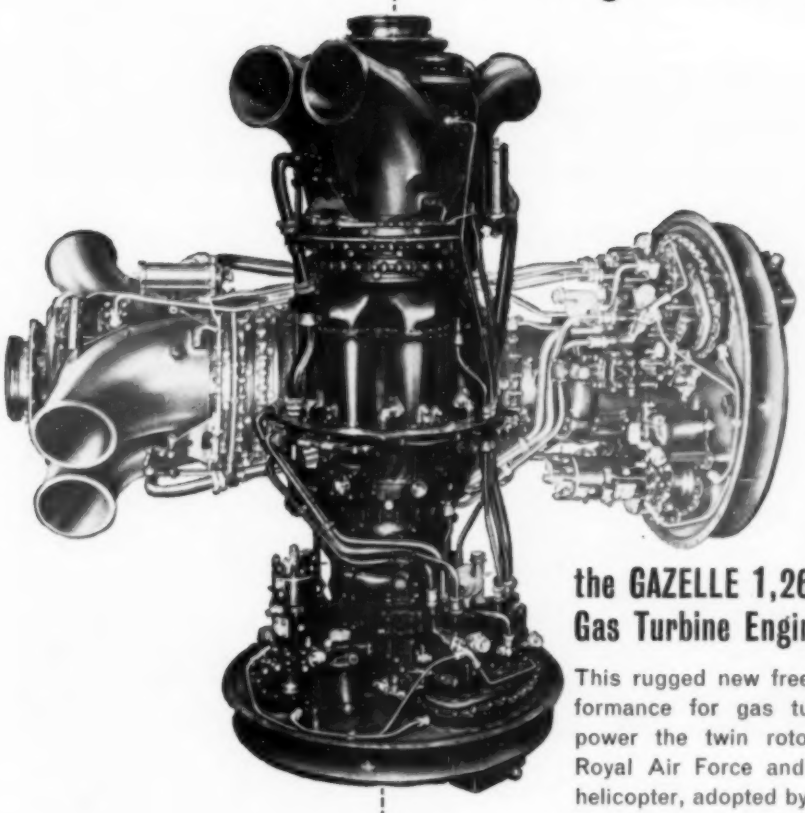

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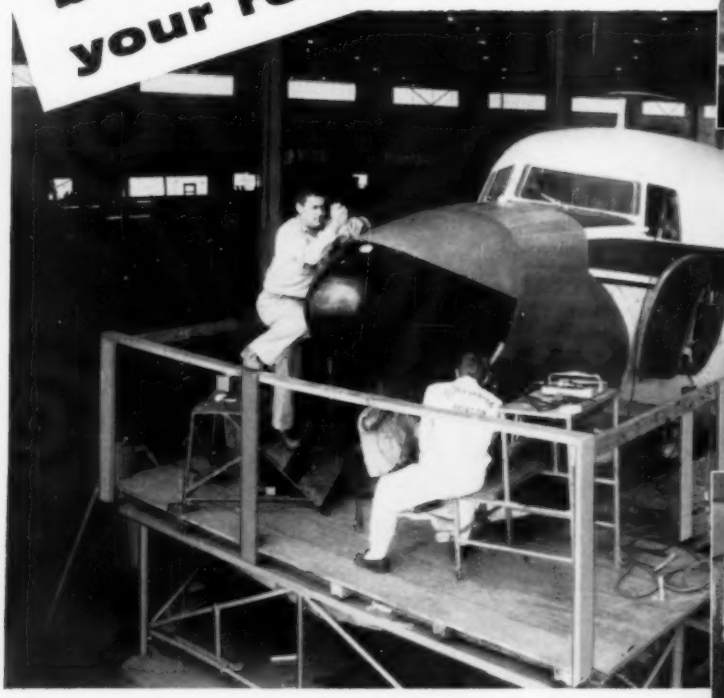

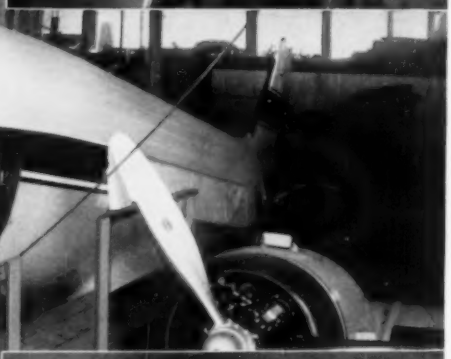

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characteristics observed during AFCRC's tests on ground-air scatter propagation:

• **Signal level varies** somewhat with the season, being higher in summer than in winter.

• **Short-time fading** intensity of 10-20 db. is experienced at a rate of a fraction of a cycle per second. Fading appears to follow a Rayleigh distribution law and to be independent of distance.

Assuming that the short-time fading follows a Rayleigh distribution, this means that 10% of the time within any one hour, the signal will be at least 5 db. above the hourly median. Another 10% of the time it will be at least 8 db. below the hourly median and 11 db. below the hourly median for another 5% of the time.

Potential Performance

Present UHF ground-air communication systems have a sensitivity, or dynamic range, of approximately 145 db., according to Rogers. This should give a theoretical line-of-sight range of about 250 mi. for an airplane flying at 30,000 ft.

However, in practice the effective range that can be achieved 90% of the time is probably no more than 70% of the line-of-sight distance, or 175 mi., Rogers said. This is because of deep nulls created by ground reflections or because of atmospheric refractive index anomalies.

If UHF communication system performance can be boosted by 65 db, it can break through the diffraction region to achieve a range of 375 mi. 90% of the time for aircraft at 30,000 ft., AFCRC's figures indicate. And if system performance could be boosted

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OOPS!

SIGHTS of rockets swooshing heavenward become more and more familiar as we thumb through today's industrial publications. The recalcitrant rocket shown on this page indicates that things *can* go wrong in research, and we don't claim that the absence of a Sanborn oscillographic recording system somewhere along the line was the reason for this disappointing trajectory.

What we do wish to say is that Sanborn equipment is playing an increasingly vital part in rocket development. Used in the laboratory to record flight behavior simulated by analog computers, and in plotting rooms at testing bases to tape down telemetered data, Sanborn "150's" are helping rockets to get and stay where they belong.

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another 10 db. (75 db. total), the range will increase to about 430 mi., or out to 520 mi. with still another 10 db. boost (85 db. total).

At lower altitudes, the scatter communication range is slightly less, as shown by AFCRC's curves. (See p. 89.)

How To Get It

If UHF ground-air communications systems are to operate in the trans-horizon scatter mode, they must be designed to achieve a 60-80 db. improvement in performance. Although Rogers emphasized that he is a research physicist and not a communications engineer, he said the following could produce the required system gain.

• **Increased transmitter power.** The airborne transmitter power could be increased from the present 5-8 watts to 500 watts, to pick up about 20 db. Such power does not appear unreasonable, Rogers said, pointing to new airborne HF transmitters which will be rated at approximately 1,000 watts. The ground transmitter could put out 10 kw., or more if required.

• **Directional antennas:** Instead of the present omnidirectional communications antennas, Rogers suggests use of directional ground arrays providing 30 db. gain, and airborne antennas providing 6 to 12 db. gain. For slower, low-altitude aircraft this might take the form of a five-element folded dipole Yagi array mounted in the nose and tail. These would have a 50-degree wide receptivity angle at the half-power points. Another possibility is a flush-mounted guided surface wave type antenna.

• **Increased receiver sensitivity.** By using a low-noise fixed-tuned RF preamplifier with a 6 kc. predetection bandwidth and tight frequency control (one part in 10^8 or better in both transmitter and receiver), Rogers believes a ground-based receiver can be designed with a sensitivity of 0.15 microvolts compared to the present 3 microvolt receiver sensitivities. The airborne receiver need not come up to these standards because of the higher ground transmitter power and antenna gain.

Two or three ground antennas might be used in a horizontally spaced combination type diversity system in order to overcome short-term fading in air-to-ground transmissions, Rogers said.

The use of space-diversity reception of ground-to-air transmissions would be helpful in overcoming short-term fading, but Rogers admits that it would raise airborne antenna design and installation problems. Another possibility is to use frequency diversity in which ground transmitter power was equally divided and radiated on two frequencies spaced about 10 to 20 mc. apart, Rogers said.

The use of speech clipping, compres-

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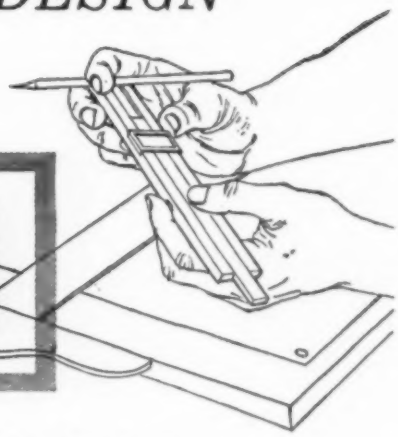

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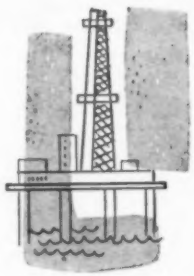

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Aircraft Controls

chosen to actuate many accessories on new Lockheed 1049G

Across the oceans of the world and over the domestic routes of America, more and more new Lockheed 1049G Super Constellations are going into service. On these advanced, long-range airliners, 14 Barber-Colman electro-mechanical actuators power various valves, scoops, and other accessory equipment.

ONE OF 14 BARBER-COLMAN ACTUATORS ON SUPER CONSTELLATION

Other Barber-Colman products on the Lockheed 1049G include passenger cabin and flight deck temperature controls, gasoline heater cycling controls, auxiliary ventilating controls, and electric windshield temperature controls.

The complete line of Barber-Colman aircraft controls includes: Actuators; Positioning Controls; Temperature Controls; Small Motors; Valves; Ultra-Sensitive Relays; Thermo-Sensitive Elements. Consult the Barber-Colman engineering sales office nearest you: Los Angeles; Seattle; Baltimore; New York; Montreal; Melbourne.

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sion, or similar techniques to increase effective signal to noise ratio might provide another 5-8 db. of system gain, according to Rogers.

Present UHF line-of-sight communications reliability is often adversely affected by surface reflected signals that combine with direct signals to form a deep null in the radiation pattern. Reflection from elevated refractive index layers may also result in regions of low field strength, called "radio holes," within line-of-sight distances.

The actual reduction of field strength is usually no more than 20 db., or 30 db. at the most, Rogers said, but this is sufficient to black out conventional UHF line-of-sight communications. However, the increased system performance required for tropospheric scatter communications would eliminate such interruptions and provide "solid coverage for hundreds of miles," Rogers believes.

Another operational advantage of going to scatter air-ground communications is the fact that the effective range will not drop off abruptly, as it now does at the radio horizon, but will decrease gradually.

If the new scatter techniques are applied to narrow-band (100 cycle) teletype communications, they should permit reliable communications to beyond 400 mi. for aircraft at 10,000 ft., with greater distances for higher altitudes, Rogers reported.

Rogers emphasizes that more tests must be conducted before AFCRC will be able to quantitatively establish all the scatter propagation characteristics needed for ground-air communications. This includes tests to measure scatter fields above 30,000 ft. and beyond 600 mi., to determine short-time fading characteristics for various altitudes, distances and airspeeds, and to measure long-term fading throughout the year.

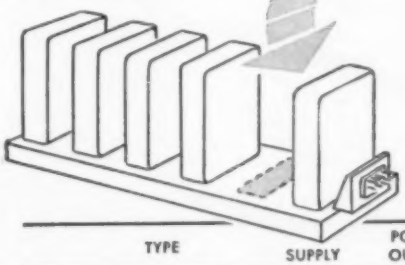
However, Rogers concludes that "in the light of our present quantitative knowledge of tropospheric scatter field strength behavior at high altitudes far beyond the radio horizon in the temperate zone, it appears possible and feasible to extend reliable UHF air-ground voice communications out to distances of at least 400 statute miles.

"Such an extension, however, will require the intelligent and forceful application of the most up-to-date equipment and operational techniques in much the same manner in which the USAF forced the break-through in ground wideband point-to-point tropospheric scatter communications."

Communication engineers who would like more details on AFCRC's tropospheric scatter tests should contact Mr. T. F. Rogers, Communications Laboratory Air Force, Cambridge Research Center, Hanscomb Field, Bedford, Mass.

Lightweight! SERVO Magnetic Amplifiers

The servo amplifiers illustrated are typical standard types. Other models, including higher power types, are available for systems engineering. The complete MA line offers the designer a choice of compact, low cost types, amplifiers featuring fast response at high gain and all-magnetic models providing highest performance.



In addition to standard types, custom designs can be produced for special applications, or complete servo and automatic control systems can be engineered to your requirements.

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MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 cps.	5, 10, 15, 20 watts	0.1 volt AC	.008 to .1
TRANSI-MAG*: TRANSISTOR + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 or 60 cps.	2, 5, 10, 15, 20 watts	.08 volt AC into 10,000 ohms	.01

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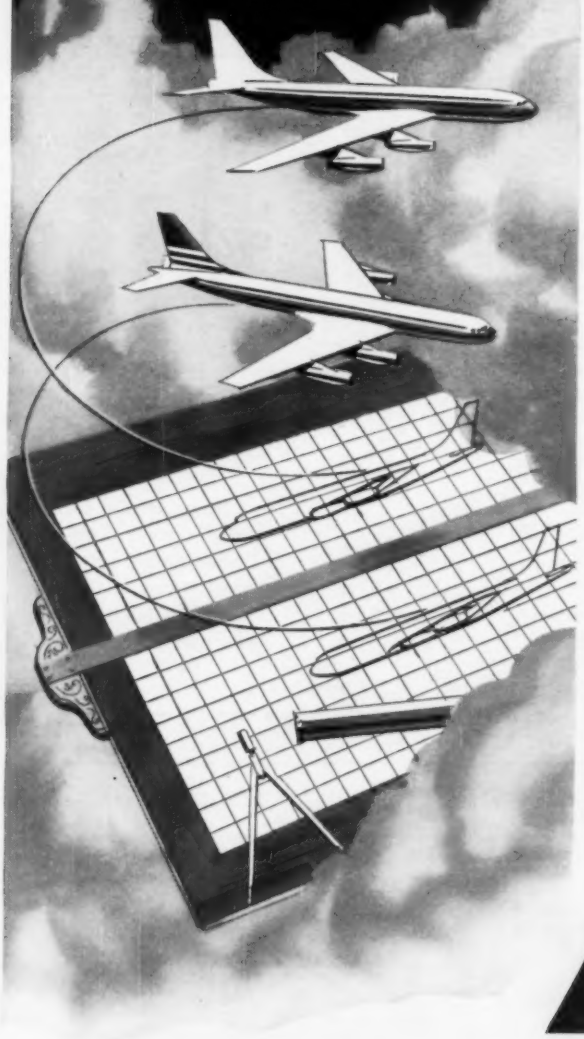

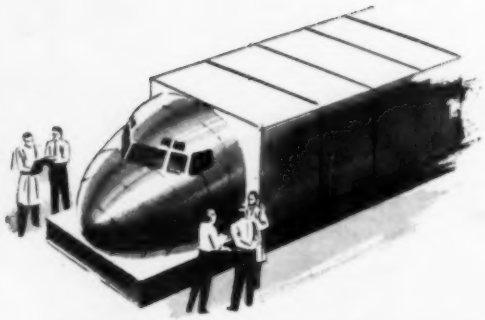

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Radar Test Stand Uses Lathe Carriage

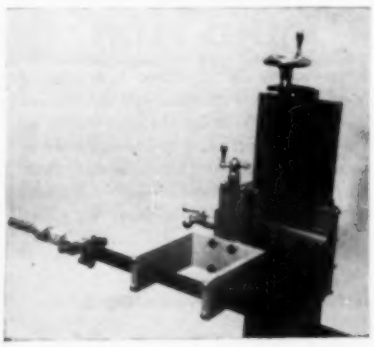
A novel radar antenna test stand which uses a low-cost lathe carriage to permit easy, yet precise, positioning of the antenna feed has been developed by Convair-San Diego.

The device speeds up to "cut-and-try" process of finding the optimum antenna feed position to give the required radar beam shape.

Convair mounts a standard replacement lathe carriage, costing less than $100, on a stand to which the antenna reflector is secured. A special clamp secures the radar waveguide and feed to the lathe carriage. (See photos) The normal lathe carriage positioning cranks permit the feed to be moved up-down and in-out very precisely.

The lathe micrometer dials permit feed position to be read off to an accuracy of 0.001 inch, according to Harold Dickstein, senior electronics engineer at Convair.

The entire lathe carriage can be moved on lead-screws to permit sideways motion of the feed. A scale on the frame permits sideways motion to be measured to an accuracy of 0.005 in. The stand is designed also to permit



KODAK COLOR PRINTER

USES

TIC

LOGARITHMIC POT FOR PRECISE

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TIC
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FOREMOST IN THE DEVELOPMENT OF NEW DESIGNS
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An important requirement in the design of the precision Kodak Color Printer, Model 1599C, is its highly accurate electronic exposure timing device. Rigid specifications set by Eastman Kodak Co. engineers for a precision 6:1 ratio logarithmic potentiometer were met by TIC — specialists in the design of non-linear function potentiometers.

TIC manufactures standard 50 db and 20 db logarithmic potentiometers of high resolution and high conformity. The unique double-contoured resistance-element card makes possible the high accuracy of all TIC non-linear potentiometers. This card design (contoured symmetrically on both edges) also permits greater flexibility in the design of non-linear functions — flexibility required for special designs like the pot used in the Kodak Color Printer.

Low temperature coefficient of resistance . . . high resolution . . . complete environmental protection . . . and precision mechanical construction add to the high conformity and reliability of TIC non-linear potentiometers. As leaders in the field, TIC design experience can help you in selecting a non-linear pot, standard or special, for your application.

Complete specifications on TIC non-linear potentiometers available upon request.

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LOCKHEED X-7 RAMJET BLASTS U.S. MISSILES AHEAD

Today's most arresting new weapons for the nation's "Perimeter of Defense" are the ramjet-powered interceptor missiles. Capable of speeds in the ramsonic realm—far faster than today's supersonic jets—these missiles are guided in flight. Spotted at strategic points in our continental defense system, interceptor missiles will guard the skies wherever invaders might venture.

Lockheed Missile Systems Division designed and built the X-7 to expedite interceptor missile development. Engineered as a ramjet test vehicle, the X-7 tests the mettle of powerful new engines.

Very sophisticated telemetering instrumentation, developed by Lockheed scientists, is crammed into every available space in the X-7 "flying laboratory." In stratospheric flight, the X-7 transmits as many as 100 measurements—speed, altitude, aerodynamic behavior—almost simultaneously down to earth monitoring stations.

Here, Missile Systems Division engineers analyze results of hundreds of flights to insure the performance of present-day engines—and to amass data vital to the development of radically new ramjet engines. After flight the X-7 is lowered gently to earth by parachute—saving millions of tax dollars, countless manufacturing hours.

At Lockheed Missile Systems Division more than 5,000 engineers, scientists and technicians are working on high-priority missile programs. Facilities at Van Nuys, California, are in full operation. New missile research laboratories are at Palo Alto, California, and additional engineering and manufacturing facilities are being built at Sunnyvale, a few miles away.

Lockheed's continuing contributions to future missile developments have created many new engineering and scientific career openings. If you value the opportunity to rise in your profession, to live and work in pleasant and healthful surroundings, write: Research & Engineering Staff, Lockheed Missile Systems Division, Sunnyvale, Calif.

LOCKHEED MISSILE SYSTEMS DIVISION • Van Nuys, Palo Alto, Sunnyvale, Calif.

the antenna reflector to be tilted in the vertical plane.

The use of lathe carriage micrometer readings, plus other linear scales and known test stand dimensions makes it possible to accurately determine the final (optimum) position of the feed relative to the antenna reflector centerlines. If a feed motion along *other* than perpendicular axes is required, the lathe carriage arms can easily be adjusted to move at any desired angle, Dickstein says.

New Instrument Receives Omnirange

A single new 3½-in. panel instrument makes it possible to obtain omnirange navigation services from a VHF communications receiver, providing it covers the VOR frequency band, without the need for a separate converter-control box.

Lear has transistorized the omnirange converter and built it into a panel instrument which also displays familiar

omni-bearing information and contains an omni-bearing selector. Reciprocal of omni-bearing is also displayed as well as a "to"-"from" indicator.

The complete package weighs only 2½ pounds, consumes less than 0.03 amps of d.c. power. Installation is extremely simple, Lear says, requiring only three connections: one to the VHF receiver, one to battery and one to ground. Unit is now available from Lear distributors, company says.

FILTER CENTER

▶ **500C Transistors?**—New type of semiconductor material which holds promise of operating at temperatures above 500 degrees Centigrade is under investigation by Servomechanisms, Inc., in its new West Coast research laboratory.

▶ **Volscan Status Report**—USAF will return its first production prototype Volscan return-to-base computer to Crosley for minor modifications sug-

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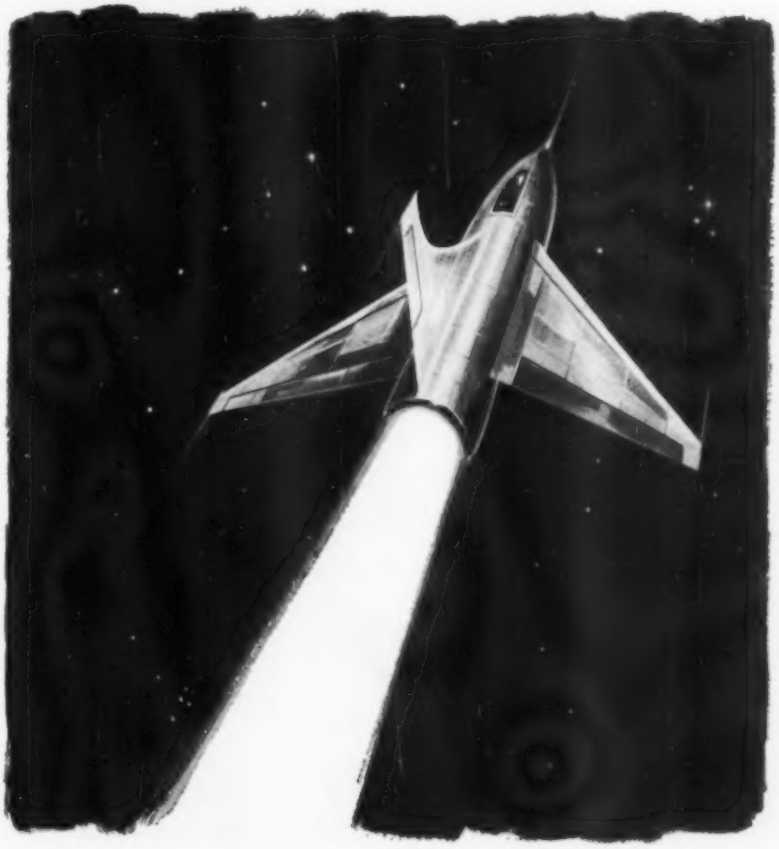

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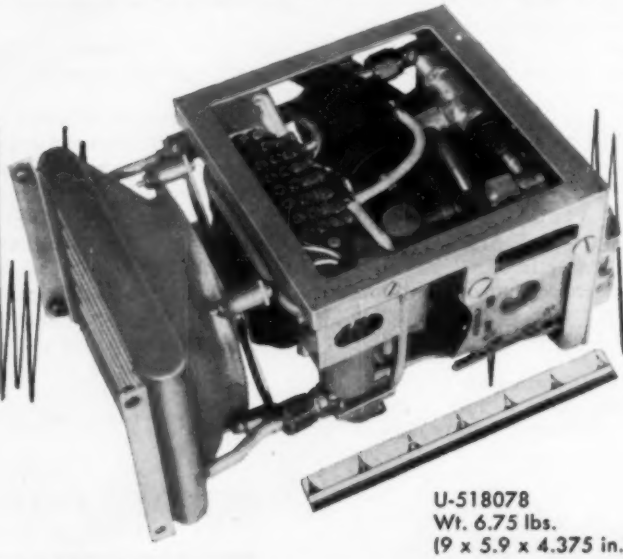

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gested by current tests at Wilmington County (Ohio) airport. After modification, Volscan computer will be set up at A. F. Cambridge Research Center's Navigation Laboratory near Boston in January to check its operation with new Automatic Voice Relay which eliminates need for human operators to relay Volscan instructions. (AW July 16, p. 89)

▶ **Russian Translations Available**—Newly formed company called Electronics Translations will publish translation of the monthly Russian electronics journal "Radiotekhnika", starting in January. Translations will include all figures and tables. Subscriptions to the service cost $150 annually for 12 individually bound issues, or $15 for single copies. For information, write Electronics Translations, Chestnut St., Concord, Mass.

▶ **New Simulator**—Link Aviation will build a quantity of F-106A interceptor flight simulators under new $3 million USAF contract. Prototype model is scheduled for delivery early in 1958.

▶ **Drone Guidance**—Sperry Gyroscope Co. has received $2.3 million USAF contract to develop a general purpose microwave command guidance system for precise control of supersonic drones.

▶ **New USAF-Navy Data Link**—Radio Corporation of America reportedly has won hot industry competition to develop new data link system for both USAF and Navy.

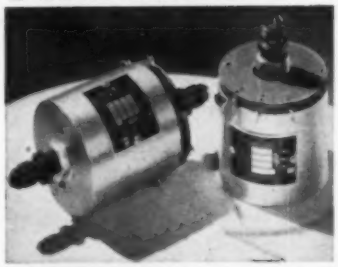
▶ **It's About Time**—U. S. Bureau of the Budget has been asked to set up separate classification for the electronics industry in Government reports and records. Los Angeles Chamber of Commerce group which recently visited Washington told Budget Bureau officials that electronics industry size and stature warrants a separate classification instead of being lumped in with unrelated industrial groups in Government statistics.

▶ **Transistorized Jets**—Minneapolis-Honeywell reports its transistorized fuel measuring systems will be used on the Lockheed Electra and Boeing 707.

▶ **Hughes PWI**—Hughes Aircraft Co. reportedly is developing a proximity warning indicator system as a competitor to the Collins PWI. Hughes-controlled Trans World Airlines has not followed lead of other major airlines in ordering Collins PWI.

▶ **Decca For New York**—Army Signal Corps expects to install Decca system in New York City area by early 1957 for evaluation as helicopter navigation aid by New York Airways.

AIRCRAFT TRANSDUCERS



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Write for Pressure Operated Potentiometer Bulletin

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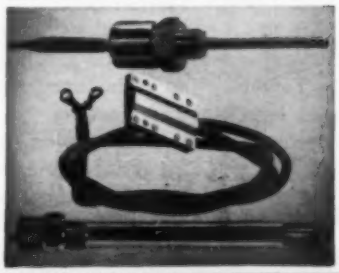

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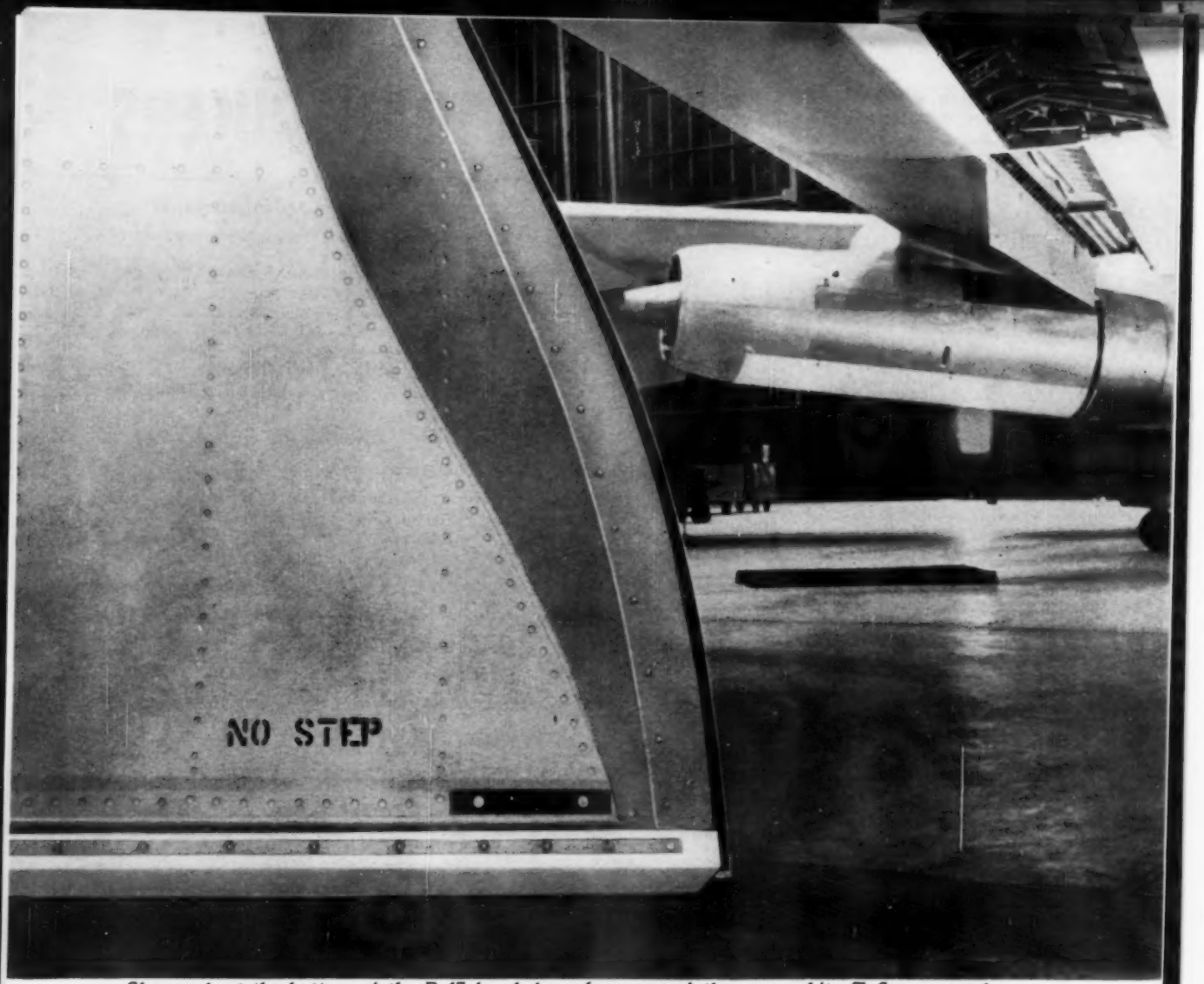

Shown along the bottom of the B-47 bomb bay door, one of the new, white Teflon covered silicone rubber seals developed by CHR.

THIS BOMB BAY DOOR SEAL COMES HOME

Modifications of the B-47 fleet include this new bomb bay door seal. In this seal, developed and produced by CHR, a heavy Teflon film is securely bonded to white silicone rubber in the same cross-section and lengths as the original organic rubber seals.

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CHR Teflon covered seals are being used on other planes where sliding action or resistance to fuels and synthetic lubricants are required.

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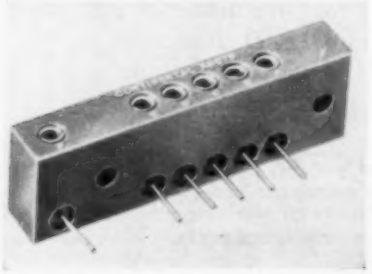
60 or 400 cps., operates without change in gain up to 170F, measures 1x2x3 in., including gain, balance and quiescent controls. Control Specialists, Inc. Inglewood 1, Calif.

• **Vacuum pressure switch,** Series GAB 1000, will respond to pressure as low as 2 in. Hg. absolute with accuracy of ±1 in. Hg. Device is not self-ac-

tuated by 10 G vibration up to 2,000 cps. Gorn Aircraft Controls Co., 845 Main St., Stamford, Conn.

• **Test point connector** for printed circuit boards will accept standard 0.080 in. test probe. Unit, designed for right-angle mounting, has six floating type contacts made of gold-silver



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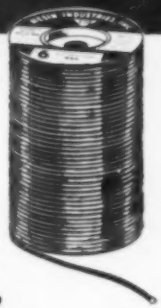
MIL-I-631C

GRADE	CLASS (Fungus Resistance)	CATEGORY (Flame Resistance)	RESINITE MATERIAL	
a	I	1	EP-69A	Approved
a	I	2	EP-69A	Approved
a	II	1	EP-69A	Approved
a	II	2	EP-69A	Approved
b	I	1	EP-69A	Approved
b	I	2	EP-69A	Approved
b	II	1	EP-69A	Approved
b	II	2	EP-69A	Approved
c	I	1	HI-HEAT 105A	Approved
c	I	2	HI-HEAT 105A	Approved
c	II	1	HI-HEAT 105A	Approved
c	II	2	HI-HEAT 105A	Approved

Grade a — general purpose. Grade b — low temperature. Grade c — high temperature. Class I — required. Class II —not required. Cat. 1 — required. Cat. 2 — not required.

Resinite VINYL INSULATION SLEEVING



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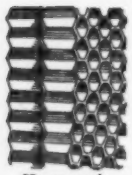
hon'ey·comb' (hŭn'ĭ·kōm'), *n.*

A mass of cells...of hexagonal prismatic form, which is the most economical of space and material.



Honeycomb.

Honeybee.

Honeysuckle

(the bees made it first...but HEXCEL makes it better)

After two years of development work, Hexcel Products, Inc. has fabricated equipment for the mass production of welded *stainless steel honeycomb. This marks the opening of a new concept in sandwich construction for the aircraft industry. Capable of greater strength than either glass fabric or aluminum honeycomb — two materials which produced the highest strength-to-weight ratios ever developed — stainless steel core provides a degree of rigidity never before achieved in sandwich structures. Stainless steel honeycomb, which has excellent strength properties at temperatures of up to 1200° F., makes lower cost, higher efficiency construction possible for any aircraft. This is one of the reasons why we say, when it comes to honeycomb, the people to see are at Hexcel: 951-61st Street, Oakland 8, California. Regional offices: 1025 W. Arbor Vitae Street, Inglewood 1, California and P. O. Box 177, Havre De Grace, Maryland.*

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plated phosphor bronze. Electronic Sales Div., DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Microwave Devices

• **X-band traveling wave tube amplifier,** Model HA-9, operates from 8.2 to 11.0 kmc. without requiring electrical or mechanical adjustments. Small signal gain is 36 db. and saturation gain is quoted at 30 db., with 30 dbm. power output. Unit measures approximately 1 in. dia. x 15¾ in. long and weighs 2 lb. Huggins Laboratories, Inc., 711 Hamilton Ave., Menlo Park, Calif.

• **One-megawatt klystron modulator,** Model PC-43, for high-power tube development applications, consists of 40 kw. X-band magnetron driver, a 15 kv. power supply with less than 0.1% ripple, and control console for remotely operating klystron and associated equipment. Line type modulator operates with pulse length of 0.5 microsecond at repetition rate from 10 to 4,000 cps. Levinthal Electronic Products, Inc., Redwood City, Calif.

Instrumentation

• **Transistorized converter,** Model FR-301, accepts variable frequency input signals from turbine flow meters or a.c. tach generators and converts to a 0-5 volt signal suitable for telemetering. Device can be adjusted to give 5 volts out-

put for wide range of input frequencies. Output voltage reportedly is linear with frequency within 0.2% of full scale and varies less than 0.2% for 5% variation in 28-volt supply. Usable temperature range is −50C to 75C. Unit measures 3 x 2 x 2⅛ in. Waugh Engineering Co., 7842 Burnet Ave., Van Nuys, Calif.

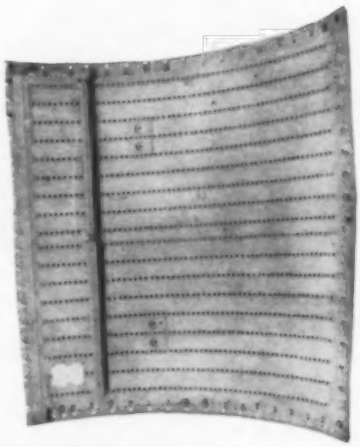
• **Tape transport mechanisms,** with speeds of 15, 30, and 60 in./sec. and flutter-wow under 0.1% rms measuring all flutter components from 0 to 300 cps using a 3,000 cps signal, provide recording time of 32 minutes at tape

GRUMMAN SOLVES PROBLEM!

Du Pont Aircraft Rivets Eliminate Mastic Coating . . . Save Time and Weight

Shaving operations and application of mastic coating to rivets used in the inner skin of its aircraft's fuel-cell liner (see photo right) was a time- and labor-consuming proposition for Grumman Aircraft Engineering Corp. of Bethpage, N. Y. With smooth-finished Du Pont Aircraft Rivets these production steps were made unnecessary. The entire assembly speeded up. Moreover, by eliminating the mastic coating, aircraft weight was reduced by several pounds.

Further reason why Grumman uses Du Pont Rivets is that these sturdy, *one-piece* fasteners resist vibration in an area where failure could mean damage to the rubber fuel containers. One man with one tool can set 20 to 25 rivets a minute —and there's no after-finishing needed. Rivets expand immediately at the touch of Precision Riveter tool, or soldering-type iron, locking units firmly together.



Du Pont offers high-temperature rivets that retain strength up to 1400°F., as well as a line of rivets for normal temperatures. For specifications and design possibilities, write E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington 98, Delaware.

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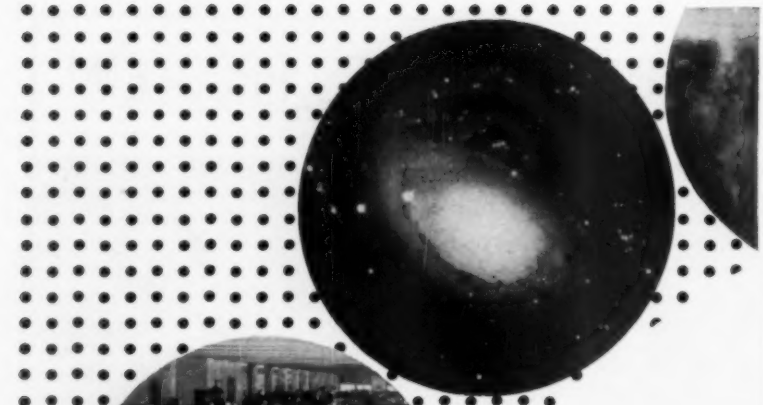

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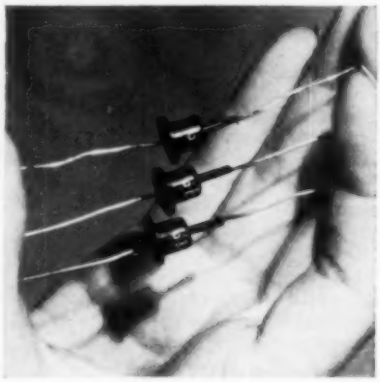
speed of 15 ips., proportionately less at higher speeds. Starting time is one second for stable tape motion at 15 ips., 3 seconds at 30 ips and 5 seconds at 60 ips. Stopping time is approximately 0.1 sec. at all speeds. Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.

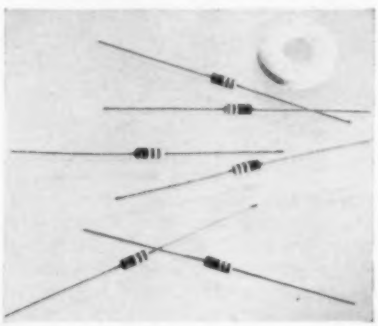
Semiconductors

• **Silicon rectifiers,** for 165C operation, are available in three new types 1N536, 1N539, and 1N540 rated for peak inverse voltages of 50, 300, and 400 v., respectively. Maximum rated output



current for the three is 750 ma. at 50C and 250 ma. at 150C. Full load forward voltage drop is 0.5 v. maximum at 150C. Rectifiers have axial leads. General Electric Co., Semiconductor Products Dept., Clyde, N. Y.

• **Silicon junction diodes,** with quick recovery characteristics, are available in new series 1N625, 6, 7, 8, and 9, rated at working inverse voltages of 30, 50, 100, 150 and 200 v. respectively. Operating temperature range is −55C to 135C, with maximum power dissipation of 200 mw. at 25C. Units recover to



a minimum of 400,000 ohms in one microsecond when switched from 30 ma. forward to 35 volts reverse, according to manufacturer. Diodes come in fusion-sealed glass envelope with axial leads. Hughes Products, Semiconductors, International Airport Station, Los Angeles 45, Calif.

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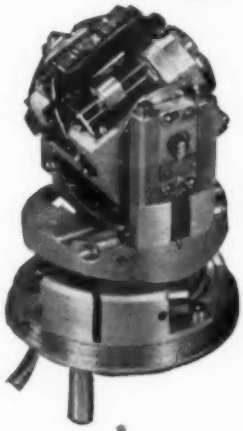

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- d. Temperature—From -65°F. to +180°F.

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- *a. Can be furnished to detect pitch, yaw and roll or combination of any two.
- *b. Accuracy—Roll Position indicated to a Minimum of ±3° over Full Range of 360°.
- c. Drift Rate—1.0° per Minute Maximum.
- *d. Gyro Freedom—Inner Gimble ±70°. Outer Gimble 360°.

3. PICK OFF DATA

- *a. Type—Potentiometer
- *b. Linearity—0.3%
- *c. Resolution—.25°
- *d. Resistance—5000 ohms
- e. Excitation—5 Volts D.C.
- f. Dead Space—2° Maximum
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*Can be modified to conform to customer's requirements.

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BELL X-1A was carried aloft thus in B-29 "mother" ship with NACA Research Pilot Joseph A. Walker at controls.

Dramatic Story of X-1A Rescue Told

Six employes of the National Advisory Committee for Aeronautics and an Air Force pilot will receive awards later this month for their roles in the dramatic rescue of NACA research pilot Joseph A. Walker just before the loss of the Bell X-1A rocket research plane on Aug. 8, 1955.

Two other employes—John W. Moise and Charles W. Littleton—already have received NACA's highest award, the Distinguished Service Medal. It was given for outstanding bravery beyond the call of duty. It has been given only once before—to Richard T. Whitcomb for the area rule concept.

Official Report Obtained

AVIATION WEEK has obtained the radio transcript and official reports which tell the story of that rescue and the attempt to save the research plane.

Moise and Littleton were crewmen in the B-29 which lifted the X-1A high above the California desert near NACA's High-Speed Flight Station at Edwards, Calif. Although it is not shown in the transcript, each risked his life by standing with one foot in the B-29 and one foot on the fuselage of the X-1A in order to lift Walker from the rocket plane after an explosion had loosened it in its moorings.

Stanley P. Butchart was the pilot of the B-29. In the radio transcript, he is referred to occasionally as 800, the call number of his plane.

Murray in the transcript is Air Force Maj. Arthur Murray, who set an altitude record of 90,000 ft. in the X-1A a year before the crash. Maj. Murray's task this day was the all-important job of chase pilot, who in many cases serves as eyes and ears for the rocket plane pilot and overall director of the drop operation, because his vantage point allows him to see both the mother plane and her charge. He was flying an F-86, with the call number 528.

UNDER ORDINARY procedure, Bell X-1A drops from belly of B-29 mother ship and rocket engine is fired. Rescue came following explosion that loosened X-1A in moorings.

Receiving Awards

Joseph R. Vensel was manning Earphone 1 in the NACA operations office at Edwards. Dick in the transcript is Richard E. Payne, crew chief inside the B-29. Armstrong is NACA research pilot Neil A. Armstrong, also flying chase, in an F-51 with the number 148. McKay is John B. McKay, copilot on the mother ship. Crossfield is former NACA research pilot A. Scott Crossfield, who was with Vensel in the NACA operations office at the field.

Walker, Butchart and Payne are receiving Exceptional Service Awards; McKay and crew members Rex L. Cook, Merle C. Woods and Richard A. Denmore are receiving letters of commendation, and Maj. Murray has been commended by NACA in a letter to the Secretary of the Air Force.

The valuable X-1A held not only

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FORMERLY PIASECKI HELICOPTER CORPORATION

NACA EMPLOYES John W. Moise and Charles W. Littleton receiving NACA's Distinguished Service Medal for their part in rescue. Left to right are Dr. Jerome C. Hunsaker, NACA chairman; Moise and Littleton, and Walter C. Williams, chief of NACA's High Speed Flight Station, Edwards, Calif.

Maj. Murray's altitude record but the speed record as well—1,650 mph., set by Maj. Charles Yeager the winter before.

Here is the radio transcript, beginning seconds before the explosion. The X-1A was at 31,000 ft. and the time was 1 min. 33 sec. before launch.

13:41:21 Walker: O.K. fuel tank pressure 24. Lox tank 45.

:33 Crew: What's the source?

:35 Walker: 2,900 pounds.

:37 Crew: O.K.

:41 Walker: X-1 battery on. You can check B-29 power off.

:50 Crew: Off.

:54 Walker: Fuel shut-off valve open. Lox shut off. (Not full word.) (Three seconds time lapse.)

13:42:02 Murray: O.K., Joe. Looks like a slight explosion. Doors peeled off outside. Are you O.K.?

:07 Crew: Let's go, Joe.

:09 Murray: You look O.K. from the outside. Joe, are you all right? You—in the bomb bay—get in and take a look at him. It blew up in the wheel well.

:14 Murray: B-29 suggest you hold your speed in case the thing comes loose.

:25 Murray: Is someone getting in the bomb bay?

:30 Crew: The lox tank is ruptured. We've got a leak up here.

:50 Murray: You are getting a little bit of fire, too. It is O.K. now. I saw a little bit of a red flame. Now you are getting a fire. Joe, old boy, get out of that thing right now and get up in the bomb bay. This is Murray. Do you hear me, Joe? O.K., Butch, better get ready in case I tell you to drop it. Get Joe out of it first.

:50 Crew: Come on out, Joe.

:54 Murray: Come on. Get him out of that thing in a hurry. You may have to drop it.

13:43:04 Crew: Get up.

:06 Murray: O. K., stay off the mike button, Bud, and hurry it, Joe.

:09 Crew: Joe closed this canopy up, and I don't know when he's going to disconnect it. Not too much, take it easy.

:31 Murray: Have they taken Joe out of the airplane?

:34 Crew: We're getting him inside now.

:36 Murray: O. K. Still looks O. K. I don't see any sign of fire yet. There was a slight fire aft of the bulkhead of lox tank.

:49 Murray: Don't see any sign of it now, however.

:59 Butchart: Joe's inside.

13:44:04 Murray: O. K. stand by Doesn't look like any fire.

:09 Crew: He's out, Major.

:12 Murray: Sure glad to hear it.

:17 Crew: Is there any sign of a fire?

:17 Crew: Bail-out bottle.

:22 Murray: Someone is calling for a bail-out bottle. Fire looks O. K. Seems to be out now.

:37 Crew: Put him on the line back there behind you.

:50 Crew: How you feel, Joe?

Butchart: How we doing back there, Major?

Murray: About the same here. No further sign of fire.

Crew: Take it easy, Joe. Just stay right here.

:59 Murray: Everything looks about the same from outside. I'm not in close enough yet to see if the bulkheads are ruptured. You kinda hit me with a piece of airplane when it blew up.

13:45:09 Crew: Gear doors are clear off aren't they, Major? Sit down, Joe. Take it easy.

:14 Murray: Yeah, the gear doors are blown off. The gear blew down and all the cowling on the right—left side of the airplane is blown

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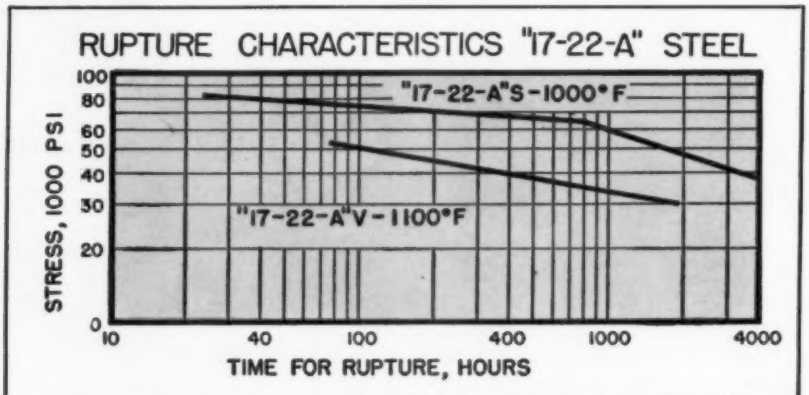

Stress-rupture curves show strength of "17-22-A" (S) at 1000° F and "17-22-A" (V) at 1100° F.

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out. Guess it was a piece of that that hit me.

:24 **Butchart:** Yeah.

:25 **Crew:** Say, Butchart, right back here where your lost manifold is—where this here panel covers it, is ruptured too.

:34 **Butchart:** In the back end?

:36 **Crew:** Yeah.

:37 **Butchart:** How are you guys doing?

:39 **Crew:** Pretty fine.

:44 **Butchart:** Are you getting any air?

Crew: Ah, yes, plenty.

:46 **Crossfield:** Turn the power off in the airplane, Butch.

:49 **Murray:** I can see up inside the lox tank. It certainly all went out at once. The frost is coming off the outside. I guess you are rid of your lox.

:51 **Crew:** Lay right there and stay out of the way.

:56 **Murray:** O. K. I'm moving out a little further toward the wing, Butch.

13:46:18 **Murray:** Say, Butch, do me a favor. Don't fly over the housing area with that thing.

13:46:32 **Murray:** O. K. Looks like the B-29 lox is jettisoned.

Butchart: O. K., thanks.

Murray: Are you going to land it, Butch?

Crew: How does it look now?

Murray: Oh, the gear is down. I can't tell whether or not it's locked . . .

13:47:02 **Butchart:** You are not coming in too good, Major. What did you say?

Murray: After you straighten out I'll move in and see if the gear is locked down.

Butchart: Yeah, kinda clumsy, wouldn't it?

Murray: Yeah, it may be rough, I'm moving on out.

:23 **Walker:** That thing shot vapor right in behind my head.

:36 **Murray:** With you, Joe. O. K. as far as I can see. Looks like it is locked down. There is an awful lot of debris in the wheel well, though.

:52 **Murray:** Can you hear, Butch?

Crew: Yeah, I can hear.

13:48:11 **Crew:** I don't see how we can land with the gear down, Butch.

Butchart: No, we probably lost all the pressure, too.

Crew: No, we still got 2,700 pounds in there according to my gage, so the source system didn't rupture. Shall I try to pull the gear up? (Electrical gage.)

Crew: You can't. The handle was already up.

:34 **Butchart:** That's right.

Murray: Now you might jettison the fuel. There's no sign of fire—and

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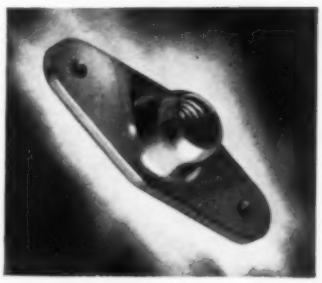

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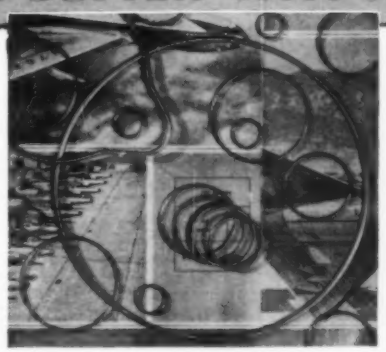

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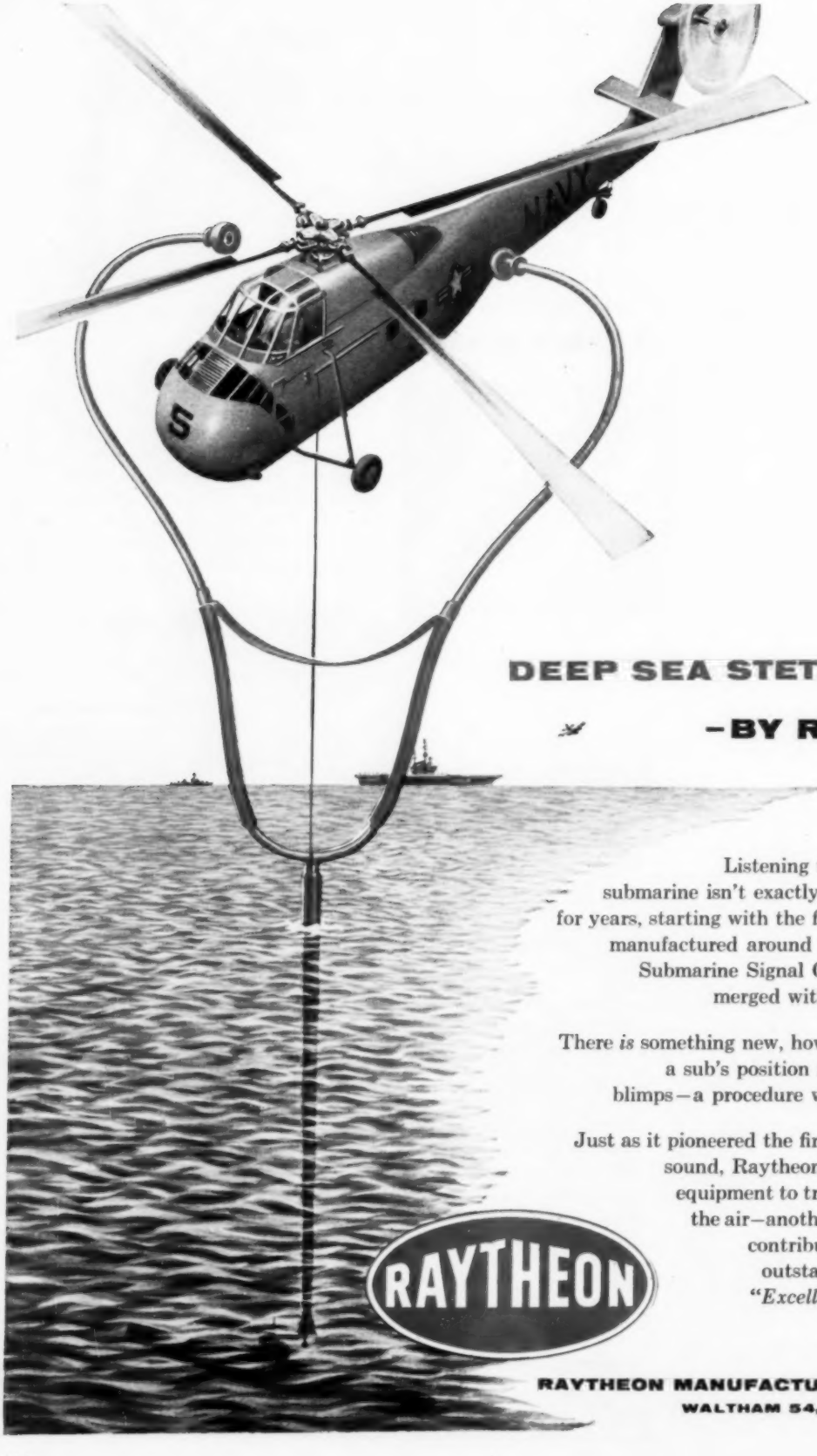

DEEP SEA STETHOSCOPE

—BY RAYTHEON

Listening to the heartbeat of a submarine isn't exactly new. It's been done for years, starting with the first crude equipment manufactured around 1905 by the famous Submarine Signal Company, which was merged with Raytheon in 1946.

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Just as it pioneered the first use of underwater sound, Raytheon today is pioneering equipment to track submarines from the air—another assignment that is contributing to Raytheon's outstanding reputation for *"Excellence in Electronics"*.

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then see how it looks with the gear down.

13:49:05 Crew: You think we ought to try to jettison the fuel?

Murray: If you are going to try to land it you certainly don't want to land it with fuel and lox on it. The lox is out, but I guess fuel is still in it.

Crew: Yes, it is.

13:49:19 Vensel: Hello, 800 this is Earphone 1.

Butchart: O. K., Joe.

Vensel: Butch, unless you can get rid of the peroxide in that airplane I wouldn't land it.

Butchart: Right.

Crew: The peroxide tank is pressurized right now. Major, is the top tube on the tail—back—the jettison tube?

Murray: That looks O. K. if you want to give it a try.

Crew: O. K. We'll have to wait until we get down here a little lower, then I can get down in the cockpit.

:54 Butchart: O. K.

13:50:06 Crew: There isn't anything coming out of the 29 jettison, is there, major?

Murray: That is all stopped now. Everything appears to be static; everything looks good.

:21 Crew: What is that vapor coming right up there by the power cable on Deck 1?

Murray: I think that is probably from the lox.

Crew: O. K.

13:51:00 Murray: B-29 can you work O. K. around 15,000 feet?

Butchart: I'll settle off between 14 and 15.

Murray: Fine, I can stay with you a little longer that way.

:11 Vensel: 800, this is Earphone 1.

Butchart: Go ahead, Joe.

Vensel: Butch, you might, after you get down lower, try to retract the gear before you try to jettison.

Butchart: Yeah.

:23 Crew: Not much possibility, Joe. The gear handle was already in the up position.

Butchart: Not unless it got knocked down by whatever came into the fuse-cockpit with Joe.

Crew: Well, the control valve is right there in the center—right where it blew up, whatever it was.

Vensel: Won't hurt to give it a try.

54: Murray: Your nose gear never moved. Just the main gear blew out. . . .

12:52:49 Crew: Major?

Murray: Yeah?

Crew: A piece hit your left wing tip right on . . . very leading edge.

Murray: Yeah, the stuff hit me all over. Just about lost a canopy out here too.

13:53:08 Crew: I saw it fly out there.

Murray: Looked pretty hairy from here. I was right in the middle of it, right up near the engine nacelle.

Crew: Yeah, I knew you were.

:20 Vensel: 800, this is Earphone 1.

Butchart: Yeah, Joe.

Vensel: It is questionable whether you should power back on that airplane, Butch. You better think about it.

Butchart: All right, Joe.

Crew: I have d.c. power off to the airplane, but I don't know whether Joe turned the battery off or not.

Butchart: Ask him, Dick. He's coming back there with you.

13:54:04 Armstrong: 528 from 148. Before you go back let me look over your airplane from the outside.

Murray: I sure would appreciate it.

Armstrong: You betcha.

:05 Murray: Butch from Murray. Are you definitely sure that the X-1 gear won't clear?

Butchart: How about that, Dick?

13:55:02 Butchart: I'm not sure at all, major, but I'll see what Payne has to say.

Murray: O. K.

:38 Payne: Were you calling me?

:45 Butchart: Payne, are you sure that the gear will not clear when it is in this position.

Payne: It will drag on the ground, Butch.

Murray: It is pretty clear, then. You either land it that way or drop it. You will take a chance on folding it up.

Crew: Of course it may be in such bad shape now it won't hurt anything other than just smashing the gear itself up.

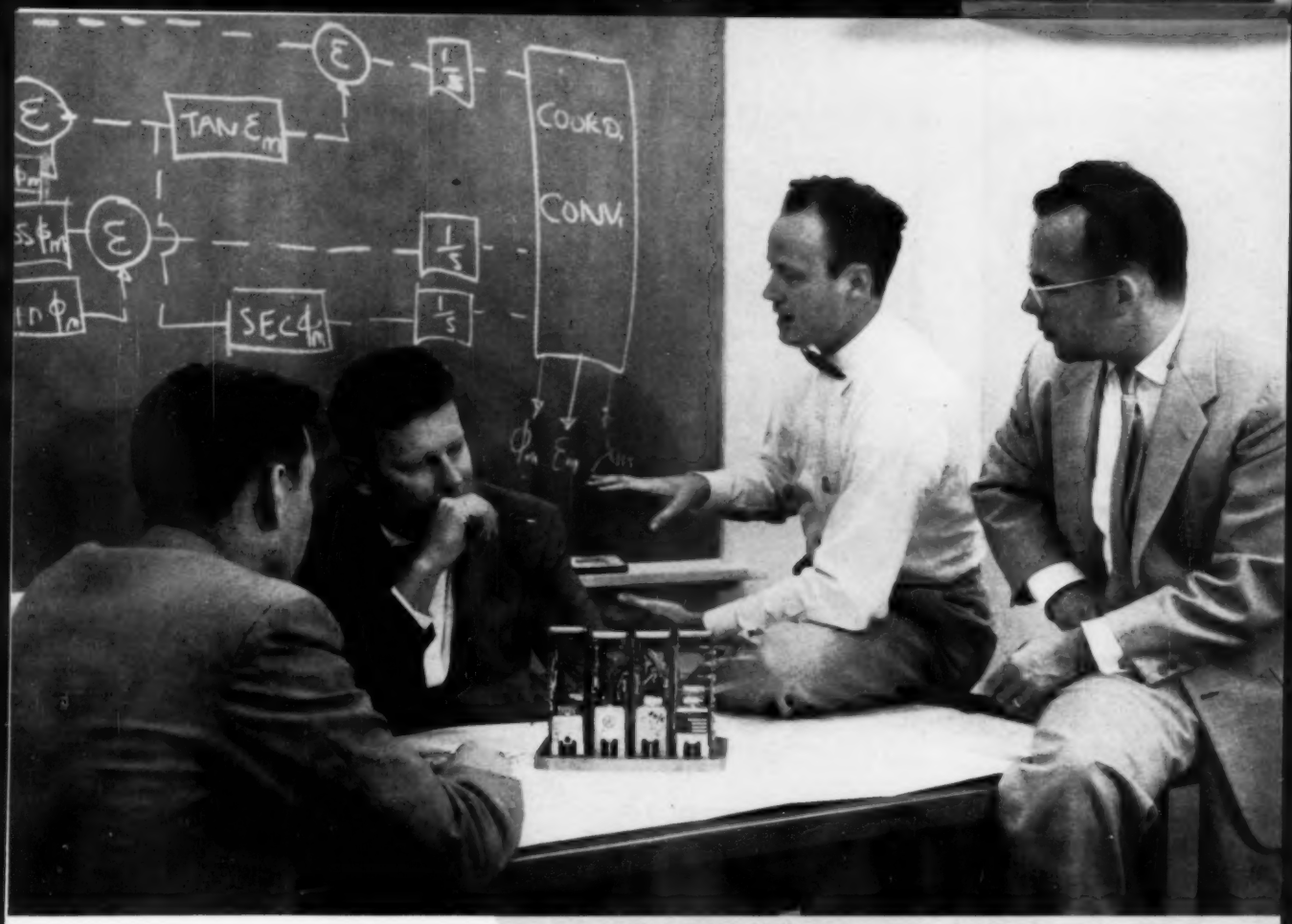
Murray: That's right. The gear I can see very well. The whole section looks full of debris. I can't see very well, there is so much junk in there.

Crew: We can take one more chance to see if the handle is up.

13:56:34 Murray: Will almost have to

Greenland Operations

Air Transport Group 6614 flew ski-equipped Douglas C-47s in establishing six sites on Greenland Ice Cap for aerial survey to determine size and shape of Ice Cap. Scientists used HIRAN, a high frequency radio system, to chart from air. Six sites, all above 9,000 ft., are manned by men of Air Photographic and Charting Service.



G. D. Schott (second from left), Flight Controls Dept. Head, discusses new techniques in the mechanization of autopilots with R. D. Wertz (left), Flight Controls Research Engineer; R. J. Niewald, Flight Controls Analysis Section Head; and B. C. Axley, Servomechanisms Analysis Group Engineer.

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be up there because your nose gear is up.

Crew: Yeah.

Butchart: Ask Walker if he left the battery on.

Crew: No, he says he thinks he shut it off. He's going in there right now.

:49 **Butchart:** Is he going to check the gear, too?

Crew: Yep.

Butchart: O.K.

:59 **Murray:** I'm going to keep about 12,000, Butch.

Butchart: Yeah.

13:57:25 **Crew:** Gear handle was in up position.

:34 **Crew:** With gear handle locked, there is no way you can put the gear up. All electrical power is off.

:51 **Armstrong:** Is there any way to determine if the gear is locked from the outside?

Crew: Major Murray says it is down and locked as good as he can tell.

13:58:02 **Murray:** I'll move in again, but as near as I can tell at altitude, it looked like the mechanism is all in place.

Crew: Can you tell—is there anything burning in there, Major?

Murray: Well, there was but it looks like it has gone out now.

:21 **Crew:** There is either smoke or lox spilling up through the 24 volt power plug right on top by the shackle.

Murray: As near as I can tell that is down and your marks are lined up. Looks to me like that gear went into lock position.

:39 **Crew:** It naturally would if it went down.

Murray: O.K., I'm out from under.

:49 **Butchart:** What would you suggest, Joe?

:56 **Vensel:** It might be reasonable to try getting rid of the propellants when you get down low enough. We are kicking around whether or not you should land even with the gear down and empty.

Butchart: O.K.

Crew: We'll get rid of the propellants.

Murray: Let's move out a little bit 148. This may call for another go around. . . .

13:59:38 **Vensel:** 800, this is Earphone 1.

Butchart: Go ahead, Joe.

Vensel: It might be well not to let Dick get in the cockpit, but have someone hold on to him and lean over the side.

Butchart: Righto.

:52 **Crew:** O. K., Joe.

14:01:49 **Murray:** Getting a jettison flow now. Pretty light, though.

Crew: Did you see some fuel, Major?

14:02:00 **Murray:** You got a burp there and now it is pretty well stopped.

Crew: We opened the emergency jettison valve.

Murray: You're not getting very much.

Crew: It will just flow by gravity out the tank if it will.

Murray: Doesn't look like much is coming out. Maybe a thimble full.

Crew: Probably.

:33 **Murray:** Did you lose fuel tank pressure too?

Crew: All the pressures were flat.

Murray: I see. It is not coming out worth a darn.

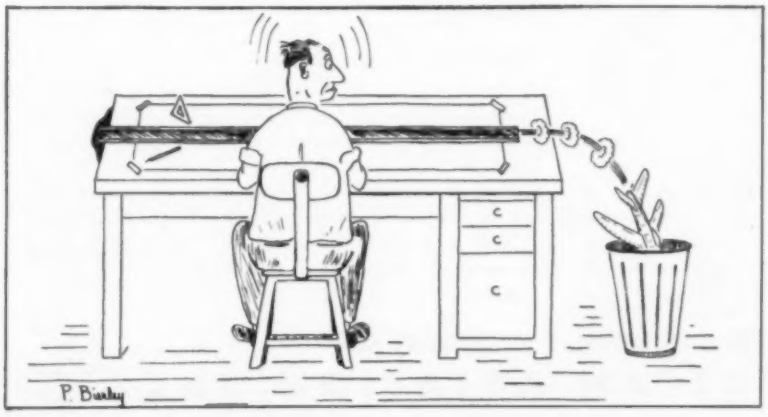
:49 **Crew:** The valves are open. Bottle pressure is down to approximately 500 pounds.

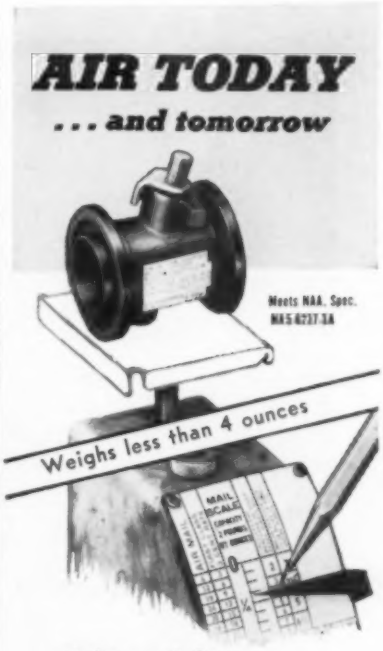
Murray: That should have done it if we're going to come out. I guess it would but doesn't look like it is coming out at all here.

14:03:07 **Crew:** We are getting something out over the top.

Crew: The top of the fuel—the airplane?

Murray: Yeah. (Not readable)





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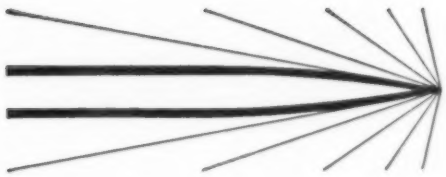
Murray: I can't see it from this side.
Crew: You mean back on the side?
Crew: I don't see it from here, either.
Crew: It's right up over the top, off the wing.
:39 (Not readable.) . . . you guys up there are asking for it.
:49 Crew: Fuel tank isn't ruptured at all, is it, Major?
Murray: No. The tank looks good from the outside. Let me cross over. Can you see that side?
14:04:18 Crew: Woody, I think that is the frost off of the lox tank you see coming back there.
Crew: It could be, Dick. I mean, it is not too much.
Murray: Fuel tank looks to be O. K. Looks like there is none coming out. Appears to be no cracks or holes in the fuel tank that I can see.
:45 Crew: See up around the shackle there, Dick?
14:05:01 Crew: Around your dorsal back here it's all busted loose around your dorsal on the back.
:15 Murray: Right up over you now.
:22 Crew: Hello, Joe. Joe Vensel.
Vensel: Go ahead.
Crew: The source pressure in the X-1 is completely shot and all the tanks are at zero. The only thing loaded is the lox dome. The peroxide tank is empty. Fuel tank is empty of pressure but apparently there's fuel in the fuel tank yet.
:57 Vensel: O. K. Stand by a minute.
Murray: You haven't jettisoned peroxide yet, either, have you?
Crew: No, we have no pressure. It won't go out by itself.
14:06:10 Vensel: 800, this is Earphone 1.
Butchart: Go ahead, Earphone 1.
Vensel: Butch, you might as well drop it. Pick a good place.
Butchart: Any special place that you want to pick it up at?
Murray: I suggest you hold it a second until we see if the range is clear.
Butchart: Yeah. Would you find a place for us, Major?
Murray: I'll sure try. . . .
14:09:23 Vensel: Listen, Butch, I wouldn't monkey around too long. Get rid of that damn thing.
Butchart: Hoping we could get the seat out, Joe.
Vensel: Negative. To hell with the seat, Butch. . . .
14:12:40 Chase: 800, what is your locate?
Butchart: Due south of the rocket range, seven miles, at 8,000 feet.
Murray: You going to drop on PB-3?
Butchart: Yeah, swinging around and am now due south of it.
Murray: Hate to see this.
Butchart: Yeah.
14:13:11 Crew: How about shooting



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the tires off of it, Major?
Murray: Wait until I get my canopy open.
Crew: O. K.
14:14:06 McKay: Major, this is 800. Can you check the stabilizer on the X-1A to see if it is 1 degree nose down?
Murray: Yes, it seems to be nose down but (not readable).
23: Crew: Say Butch, we are getting a funny odor back here.
Butchart: Roger.
:37 Chase: You position again, 800.
Butchart: East of PB-3 about 4 miles. Swinging around to the north now.
Chase: Altitude?
Butchart: 6,500.
Crew: Hey, Butch.
Butchart: Yeah?
Crew: We smell something getting hot back here.
Butchart: O. K.
Crew: How long will it be?
Butchart: About another minute.
14:15:05 Vensel: Butch, this is Joe. You'll pull up pretty good when you let go of it.
Butchart: Yeah.
14:16:29 Murray: It's all clear.
McKay: Where's she heading?
Murray: She's going to hit just east of PB-3. Going down tail first. Real good position. That's all.
14:17:27 Butchart: Got a pretty good brush fire going down there.
:50 Crew: Butch, that thing was getting hotter and hotter. You could smell it real. I was sweating it out, boy.
Butchart: She is all right now, isn't it?
Crew: Yeah, all over.
Butchart: Any more fumes back there?
Crew: It's pretty good. I'm going to open the door now.
14:19:39 Vensel: 800, this is Earphone 1.
Butchart: Go ahead, Joe.
Vensel: How is Joe Walker doing?
McKay: Pretty good. Think he needs a vacation.
Vensel: Roger.
McKay: Say, Woody, you ready for that beer?
14:22:47 Armstrong: 800 from 148. 800 from 148.
Chase: 800 from 662. Over.
Crossfield: Hey, Neil, will you look over the bottom of the 29 for those people?
14:24:52 Chase: Earphone 1 from 662. I see three wheels down, flaps. From a little distance he looks good.
14:26:17 Chase: B-29 setting down now.

Crew Statements

Here are the statements prepared for the Accident Investigating Committee by

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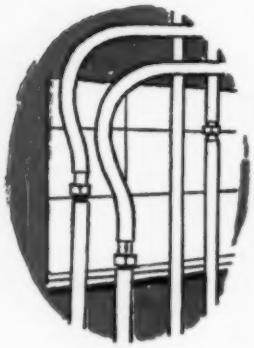

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some of the pilots and crewmen in the three days following the loss of the X-1A:

Butchart:

1. As has been our practice on all drops during the past four years the co-pilot does the actual flying during the climb and drop while the pilot coordinates the operations and sets up the actual drop time, starting at the six minute warning. As pilot of the B-29, I was calling out the minutes remaining. Our launch check-off sheet calls for a six minute warning followed by a five minute warning and then nothing until the 70 second warning. On the few operations we have had with the X-1A I have been calling out each minute to help the crew, as they had been reaching the two minute point with about three minutes work left. The same was true on this flight, but I called off the two minute warning knowing it would be something over that time to drop.

2. During this time my attention was divided between three things: keeping an eye on the engineer's panel as the Number 4 engine was hot, showing 260 degrees to 261 degrees on cylinder head temperature and I had already had the engineer open the cowl flaps twice (a degree more each time); watching our flight path as any delay in drop brings us in too close on drop; and at the moment of the explosion I was turned around part way in my seat, working off the launch check-off list as Walker or the crew called out each item. I had my left hand on the "mike" button on the wheel ready to call a "60 seconds to drop" after Walker completed item number 48. I heard him call "fuel shut-off valve open" and "lox shut-off valve open." At the time it did not seem that the explosion hit during this last call. It took what seemed like a few seconds for me to realize that it was an explosion in the bomb bay—at first I thought we had hit another airplane because the B-29 lurched nose-upward, or I thought one of the B-29 engines had blown up as there was a slight yaw to the B-29. Apparently these thoughts occurred rapidly because by the time I realized it was the X-1A and my right hand went for the drop lever I met McKay's hand just reaching it and I had already made a pass at the front instrument panel where the emergency drop handle in the other B-29 (No. 137) is located. I started to pull the safety wire out of the safety pin that goes through the drop lever. I stopped, leaving my fingers looped under the wire, why I'm not sure, but Major Murray called about this time saying we had had a "small" explosion but that everything looked "O.K." now. I didn't want to get all the "safeties" pulled as the lever is in a position that can be bumped quite easily with any moving about from the co-pilot.

3. McKay must have thought I was having trouble with the wire, because he proceeded to pull the wire and the pin and held the pin up so I could see it. Things were happening mighty fast about this time and I recall turning around, either before or after this pin pulling stuff, and I saw Jack Moise picking himself up off the floor and he moved toward me a little way looking at me with that look in his eyes "what do we

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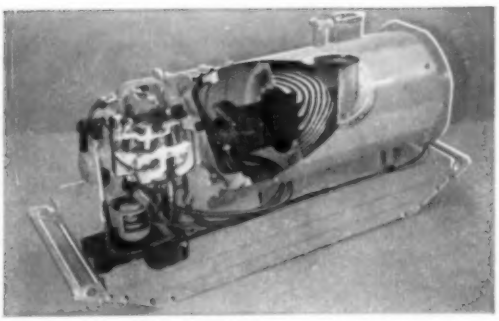

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do now?" About this time Murray made his second call saying we should get Walker out, that there had been a fire but it was out now. I saw Moise get into the bomb bay, and then Littleton seemed to balk in the doorway. It seemed as if Payne were trying to get him out of the way or out into the bomb bay. It seemed like an agonizingly long time before they pushed Walker into the B-29.

4. I got the B-29 engines throttled back and started an immediate descent letting the speed build up to 250 mph. We had indicated about 200 to 210 mph. at the time of the explosion and were at 31,000 feet.

5. When Walker came into the B-29 he landed on his belly and sort of crawled up to the box that is beside the pilot where he sat down and leaned forward. I had to lean out into the aisle to get a look at Walker's face as he still had the T-1 suit face piece on. It looked as if he were trying to hold his breath, but his face was already turning quite blue—in fact it looked purple. I watched his face while about three or four others were wrestling with the "walk around" bottle located behind the co-pilot. I told someone to put him on one of the oxygen hoses in the back but two walk around bottles showed up at the same time and I had already unplugged Walker's oxygen hose from the "T" and I shoved it into the first bottle they held up. Walker took one breath and started to smile and I held my hand in front of his face to show him that things were O. K. He did not pass out at any time as I had his face where I could watch it at all times, and I also had his "green apple" on the T-1 suit bottle where I could pull it at any time, but this was going to be a last resort as I knew how immobilized he would be with the suit inflated, and also I was not sure how he would make out breathing in the suit as it takes such a conscious effort to breathe when on the full pressure.

6. Things went along rather smoothly from then on. I recall checking with the crew in the tail end and felt better when they said things were O. K. back there. All during the descent I kept thinking of the X-1-3 accident and wondering how we got away with only one explosion and needless to say I was relieved when the decision to jettison the ship was made, and more relieved when it was dumped. I asked Major Murray to get us a target assigned and someone called saying that PB-3 was clear. I was south of the main lake at the time about 12,000 feet and headed for the target so I could make the drop from north to south. I came over the target about 230 mph. in a slight left turn and started a pull-up, planning to drop at about 200 mph. so that the X-1A would not have speed enough to fly up at us as it was extremely tail heavy without a pilot and an empty lox tank. The normal drop lever failed to release the X-1A and I banged the micro-switch two or three times before turning around and calling to someone standing near the emergency drop hand to pull it. I felt the X-1A drop away and heard someone say it was away clean. I circled the target once and saw the wreckage about ¼ to ½ mile south and a little east of the target. A small fire was still burning and I could see marks on the ground showing the force of the explosion had gone out each side quite far but

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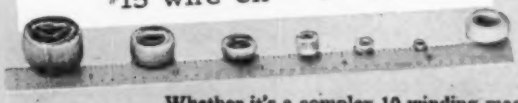

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not much fore and aft. I swung in over the lake, lowered the gear and an F-100 passed under me apparently checking our gear as I heard someone say it looked O. K. Also had a report from the scanners that all looked O. K. The landing was to the southwest on the lakebed. The B-29 handled normally in all respects.

Murray:

I took off at approximately 1415 hours PST, in F-86, S/N 52-5528, to act as close escort on the X-1A. Formation was joined with the B-29, with the X-1A aboard at 1425 hours, 27,000 feet, near El Mirage Lake. The NACA P-51 was flying right wing and moved aside to allow me to take position. Lox top off was in progress at this time. The lox top off of the X-1A and the climb of the B-29 appeared normal except for excessive No. 3 engine oil temperature. During the climb, the F-100 piloted by Captain Schalk as high escort aborted, due to loss of cabin pressure.

Approximately ten (10) minutes before drop, the lox flow through the X-1A auxiliary vent valve began to diminish. Top off was continued but at a reduced flow. Approximately six (6) minutes before drop, the B-29 entered a left turn and the lox flow increased slightly to normal proportions.

I called the B-29 panel operator to be sure that the lox top off pressure was normal. The panel operator reported top off pressure of 50 psi. External indications were that the lox tank was full at 10 minutes before drop, but the flow diminished because of impending exhaustion of the B-29 top off lox. After fuel tank was pressurized, a slight leak from the fuel pump was noted flowing rearward along the dorsal fin at the aft end of the airplane. It was not of sufficient magnitude to abort the flight. Fuel jettison was checked and appeared normal both for initiation and for cut off. Lox jettison began normally but did not cut off when the jettison switch was moved to closed. The sticking jettison valve allowed jettison to continue at a reduced rate for approximately 30 seconds after the switch was moved to "off." A large amount of lox which swirled around the aft end of the X-1A during lox jettison apparently was caused by a cracked plastic transfer line. At an estimated two (2) minutes before drop, I started to move in close to make a final check for leaks and for positive closing of the lox auxiliary vent valve. As my airplane passed under the wing of the B-29, and approached the wing of the X-1A, the X-1A exploded. I saw a small cloud of white vapor in the vicinity of the wheel well. Part of the X-1A blew out of this area and some of the parts struck my airplane. I heard the sound of the explosion almost simultaneously with the impact on my airplane. Immediately thereafter, my airplane was enveloped in a dense white cloud of vapor. The vapor was carried to the rear with the airstream and I moved forward to see what had happened. While moving forward I called for the B-29 personnel to get into the bomb bay immediately and to get Mr. Walker out of the cockpit. I reported that an explosion had blown down both main gears and had blow off the structure around and forward of the main gear on both sides of the airplane. Immediately after the lox dissipated, a small dull, dirty red color flame existed in the center section

Boeing engineers design America's first jet transport

Pictured above is the full-scale cabin mock-up of the Boeing 707, America's *first* jet transport. In developing this interior, Boeing engineers helped design features and innovations as advanced as the 600-mile-an-hour performance of the aircraft itself.

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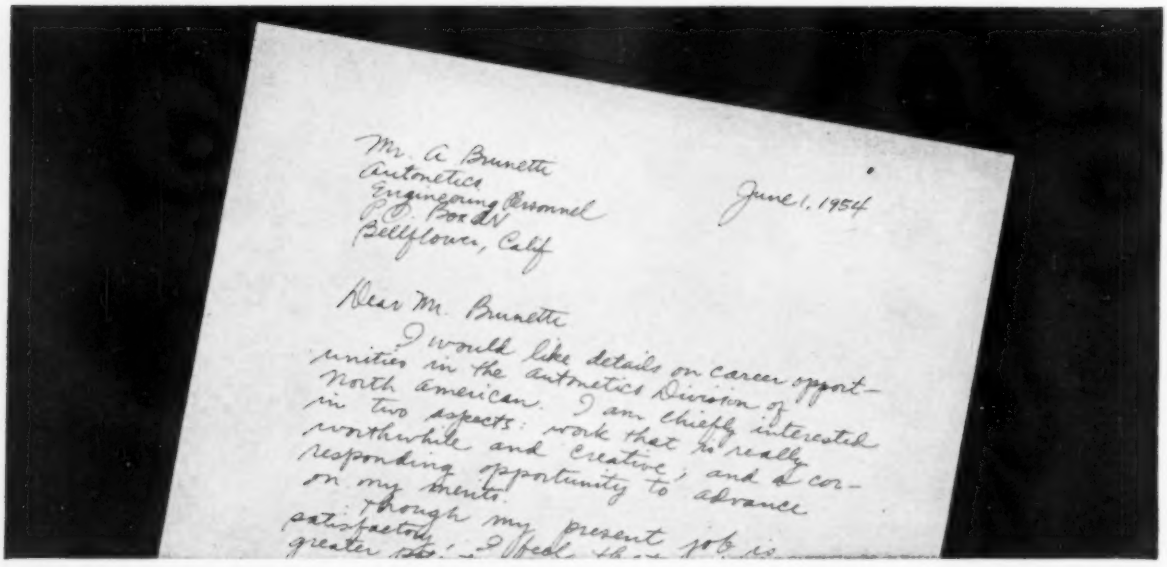
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Autonetics
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P.O. Box AW
Bellflower, Calif
June 1, 1954
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between and slightly above the nitrogen source bottles. The flame slowly died out and disappeared in an estimated thirty (30) seconds.

I instructed the B-29 to keep up its speed so that Joe Walker would be able to fly in case the X-1A fell off the bomb shackle before he got out of the airplane. Once Mr. Walker was out of the cockpit, it appeared that the situation was static. I decided against asking the B-29 to drop the X-1A before an attempt was made to return the X-1A to the base, so that the cause of the accident could be determined.

At 15,000 feet the B-29 personnel reported that X-1A source pressure was still available. The B-29 descent was stopped at 11,000 feet MSL and Mr. Walker and Mr. Payne reported they would attempt to look into the X-1A cockpit. It was found that the source pressure was gone and that all tanks had gone flat. The only pressure in the airplane normal system was 20 pounds in the fuel dome. I moved in close again and saw that the gear mechanism was in the over center and locked position. Still hoping that it might be possible to return the airplane, I asked if the ground station would recheck the clearances with the X-1A gear extended during the landing of the B-29. Meanwhile, an attempt would be made to jettison fuel. The manual emergency system was used but no more than a cup full was ejected. No peroxide could be ejected because there was no tank pressure. At this point it was apparent that because of marginal ground clearance and the fact that fuel and peroxide being still aboard, it would be necessary to drop the X-1A. Accordingly, I relayed this information to the B-29 and switched channels to find a clear range. The Operations Division cleared us to use PB-3. During establishment of the standard bombing pattern at low altitude on PB-3, thin vapor began coming from the X-1A and scanners reported smelling peroxide. At this point I asked Mr. Butchart to make it as tight as possible to get rid of the X-1A.

The B-29 descended to 6,500 feet in a dive to pick up speed to 200 knots, then pulled up steeply to 7,000 feet. The X-1A dropped from the B-29 in a tail low attitude, went beyond vertical and then fell off to level flight in the beginning of what became a tail first spin. At this extreme aft CG position, the airplane spun alternate turns level, then tail down. The airplane struck the ground approximately a mile east of PB-3. Upon impact, the fuel burst into a large mushroom flame. Ten (10) seconds after impact and while the debris was settling to the ground, a sharp brilliant explosion took place which I assessed to be the peroxide tank. Low on fuel, I pulled up and the P-51 and F-86 checked my airplane for damage, gear up and down. A normal landing was possible. No damage to the B-29 was noted in flight. Damage to the F-86 appeared to be minor.

Moise:

1. Everything was normal up until the time of the explosion. I was standing at the forward entrance of the bomb bay watching the X-1A when the explosion occurred. I was either knocked down by the explosion or by a crew member standing next to me. When I got to my feet and looked back in the bomb bay it was filled with either lox vapor or hydrogen peroxide vapor which cleared up almost immediately.

2. Then I went down to the bomb bay to help the pilot back into the B-29. After the pilot got out, I noticed some damage which seemed to be on the right side of the liquid oxygen tank area. I also noticed that the right main landing gear was down.

3. Then I went back to the forward part of the B-29 to get a better look at the X-1A to see if there was any more damage or fire. I then noticed either liquid oxygen vapor or smoke running from around the power plug located on top of the X-1A.

Littleton:

1. In my estimation all pressures and readings on the B-29 rocket panels were correct just before the explosion. Not being an expert, though, I could not say for certain if this was right.

2. I was standing with my back to the bomb bay door when I felt the blast of the explosion hit me in the back.

3. Looking into the bomb bay it seemed to be filled with smoke. I followed Jack Moise into the bomb bay and we took the canopy off of the X-1A. I then climbed back into the B-29 and pulled Walker out of the cockpit of the X-1A through the door.

4. While helping Walker back into the B-29, Moise shoved on Walker from the bomb bay. Walker more or less ran over the top of me toward the engineer's seat. I started to get up but meantime Moise came through the bomb bay door knocking me

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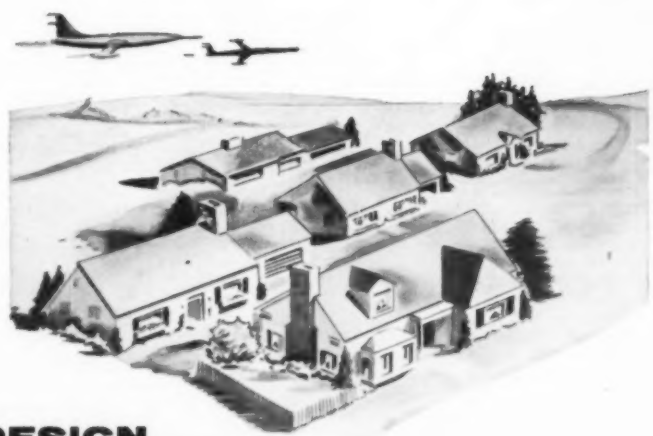

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down again. He ran forward to connect Joe Walker to the oxygen bottle. He could not get the bottle by the engineer's seat so he had to come back to the seat by the bomb bay door to get the walk-around oxygen bottle for Walker.

5. The next thing I remember is that they were trying to decide about the vapor coming out of the access door at the main power connection out of the top of the fuselage, whether or not it was liquid oxygen or hydrogen peroxide. In my estimation it was not liquid oxygen because it was not forming frost wherever it hit. I also noticed that the right gear was down with the door missing. After due time they took the X-1A out and dropped it.

Walker:

1. The preparations for launch proceeded according to normal schedule up to the time the explosion occurred. I entered the X-1A at 8,000 feet. Lox top-off was started at 22,000 feet. After top-off had continued for some time the X-1A lox manifold shut-off valve was opened and prime switch turned on to allow the lox pipe to be cooled down by gravity flow. This was stopped after a few minutes and accomplished again about 8 min. from anticipated time of launch.

2. Six minutes before launch, the X-1A photopanel camera was turned on, first stage pressure raised to 415 psi., governor balance set at 350 psi., fuel and H_2O_2 pressurizing and vent valves switched to pressurize and fuel tank pressurized to 24 psi. The H_2O_2 tank pressure was 385 psi.

3. After lox top-off was disconnected the lox auxiliary vent was closed. The normal lox pressurizing and vent valve was in the pressurize position from the ground up. The lox tank was then pressurized to 45 psi.

4. Operation of the fuel jettison valve was checked and found normal. The lox jettison was checked and three operations of the control switch were required to close the jettison valve. At this time the first stage was checked at 410 psi., fuel tank 25 psi., fuel dome 40 psi., lox tank 45 psi., lox dome 60 psi., governor balance 350 psi., H_2O_2 tank 385 psi., and source pressure 2,900 psi.

5. The X-1A battery was then turned on and external power from the B-29 turned off. The fuel manifold shut-off valve was opened. Then the lox manifold shut-off control switch was switched to open and at that instant an explosion occurred with a loud bang and I received a severe jolt from the rear. The lox tank pressure immediately went to zero and the source pressure dropped rapidly. Electrical power failed at the instant of the explosion.

6. I shut off all power switches, dumped the cockpit pressure and was assisted in exiting from the X-1A.

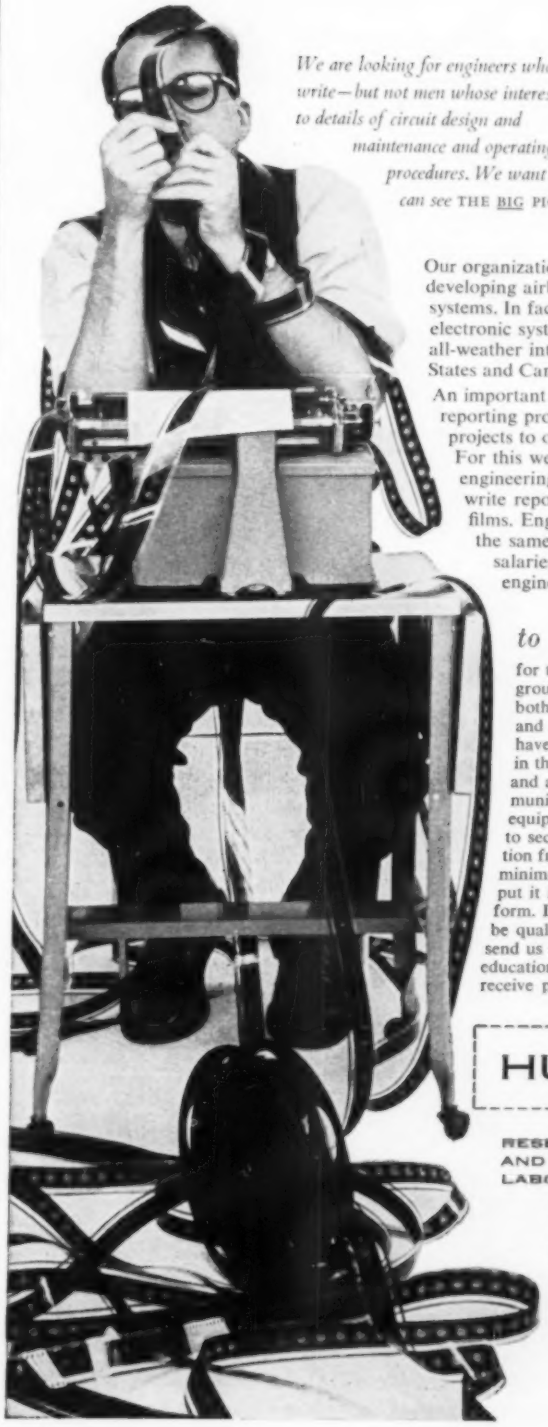
7. After the B-29 descended to 12,000 feet a check of the X-1A pressure was made and fuel tank dome at 20 psi., lox dome at 20 psi., and governor balance at 350 psi. were the only pressures not reading zero.

8. An attempt was made to jettison fuel by actuation of emergency jettison valve but this was unsuccessful.

9. Damage visible from the front of the B-29 was that the X-1A landing gear was extended and gear doors were missing.

10. The X-1A was dropped on PB-3 and landed tail first and exploded.

Can you see THE BIG PICTURE?



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TRANSLAND'S Ag-2 farm plane is rolled out at Torrance, Calif., Municipal Airport for its maiden flight.

Specialization Moves Ahead in Planes

Aircraft manufacturers are striving to break through the barrier of obsolescent war surplus agricultural planes with new high-performance, especially designed types. Of the trio of spray/dusters pictured on these pages, two of them are U. S.-designed, the other an Australian product.

Most sophisticated is Transland Co.'s Ag-2, which started its test program Oct. 11. Takeoff was made in less than 400 ft. at 4,033 lb. gross weight. Pilot Robert (Bat) Masterson, a graduate of USAF's Experimental Flight Test School at Edwards AFB, climbed the Ag-2 conservatively to 2,500 ft. at 1,400 fpm. at normal rated power on its first flight.

Design gross weight is 6,000 lb. Powered by a 450-hp. Pratt & Whitney R985 engine, the Ag-2 is designed to fly at 80 mph. at full load with flaps down using 58% power. Normal cruise speed is 142 mph. Details of the Ag-2's characteristics were reported in AVIATION WEEK July 2, p. 83-84.

Transland plans a world-wide dealer sales and service organization. Price, complete with dust and spray dispensing systems, will be approximately $25,000.

The company anticipates completing the balance of the plane's flight test program for Civil Aeronautics Administration Part III by the end of the year.

A more unorthodox approach is evident in the new PL-7 Tanker being tested at Bankstown, Australia, by Kingsford Smith Aviation Service, Ltd. Designer L. Pellarini believes that the stubby fuselage and tail-boom configuration will result in more efficient spray patterns than are possible with more conventional types.

TEST PILOT Robert Masterson takes off in Ag-2 to begin tests for CAA certification.

Conventional Position

How these are obtained is not clear, for the plane mounts the spray nozzles in fairly conventional position under the stub wings and it has been field-proven that wing-tip and propeller vortices, rather than the fuselage, play the greatest havoc with spray patterns.

Designed to carry a payload of approximately 1½ tons, the PL-7 will cost approximately $35,000. L. E. Phelan, North Hollywood, Calif., aircraft parts distributor, said that the Australian company would like to have the PL-7 produced here. National Aircraft Corp., Burbank, Calif., is reported to be interested.

Fuselage of the PL-7 comprises two main sections, the forward portion being a welded mild steel tank forming a hopper carrying spray/dust material. Engine mount and nose wheel are attached to the forward face of the hopper. On the tank's rear face is fitted the aft fuselage. Rear fuselage is fabricated of welded steel tubing with lower half of the structure carrying the main loads.

Top wing is of composite construction having a D-section torsion box of riveted aluminum alloy. Trailing edge ribs are made of welded steel tube, each rib being bolted to the aft face

AUSTRALIAN PL-7 displays unorthodox approach in an effort to obtain more efficient spray patterns.

for Farm Use

of the box and fabric covered rearward from the spar. Lower wing is of welded steel tube, fabric covered with detachable leading edge.

The complete tail is carried on two four-inch diameter tubular steel booms projecting from the rear face of the center section spar and braced to the tank section. Control cables are mounted externally.

Dimensions of the PL-7: span (upper wing), 40.8 ft.; (lower wing), 30 ft.; wing area, 405 sq. ft.; overall height, 12 ft.; overall length, 24.5 ft.; Weights: empty, 2,230 lb.; gross, 5,000 lb. Fuel capacity is 60 gal.

Performance data includes: top speed, 127 mph.; cruise speed at 75% power, 112 mph.; operating speed, 70-90 mph.; rate of climb, fully loaded, 740 fpm.; still air range, 360 mi. Take-off distance to clear a 50 ft. obstacle is given as 475 yd.; landing distance as 140 yd. (with empty hopper).

Few details are available on the Clark 1000, which superficially resembles the World War II Stearman PT-17 conversions it is designed to replace. Powered with a 220-hp Continental engine, it is reported to have flown satisfactorily with a 1,000-lb. payload, although this does not bring the plane to full gross weight. Fuselage is semi-monocoque metal construction; wings are of stressed-skin construction with metal ribs.

Landing gear is a conventional tripod type with rubber shock cords. The Clark 1000 has been flight tested approximately 60 hr. Clark Aircraft Co., Inc., is located in Marshall, Tex.

DESIGN departures in fuselage and tail were made in PL-7 by designer L. Pellarini.

CLARK 1000 superficially resembles Stearman trainer. Construction is all metal.

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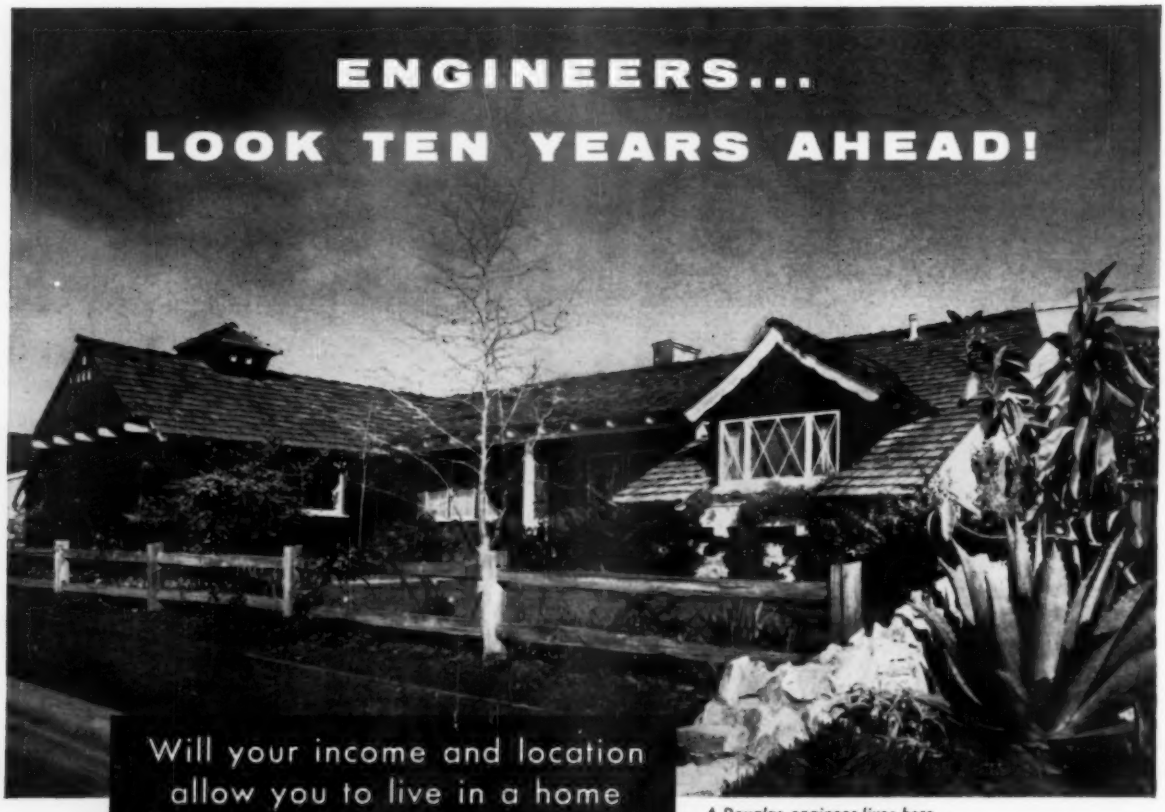

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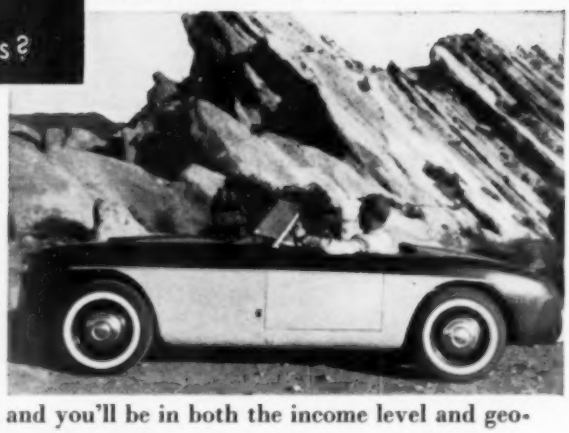

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Hundreds of copies of a 30-page booklet cataloging the airports and their facilities are being distributed. Ten fields are described in the current offering, but more will be added. Maine's Department of Development and Commerce at Augusta, says that there are approximately 74,000 ft. of practically unused runways scattered around the state.

It notes that its initial efforts to have industry build on these sites has resulted in inquiries from several aircraft and aircraft parts manufacturers.

PRIVATE LINES

Learstar Mk. 2 conversion has been ordered by Minnesota Mining & Manufacturing Corp. on a Lockheed Lodestar used by board chairman W. L. McKnight. The 3-M order brings the total number of Learstars on order and in service to 26.

First phase of flight tests has been completed by French Boisavia Anjou light-twin five-seater. Top speed has been established as 185 mph., cruise speed as 155 mph. Powered by 170-hp. Sneema engines, the Anjou has a 1,100-mi. range.

Engine overhaul rate of 500 monthly is being handled by Dallas Airmotive, Inc., Dallas, Tex. Firm has added the Lycoming V0435-A1B helicopter engine for the Bell 47G and 47J to its lines and is in the process of overhauling 250 Lycomings. The company recently acquired a 20,000-sq.-ft. warehouse building for parts storage.

Japanese will build 180 Cessna L-19A liaison planes under license costing $100,000. Planes will be built by Fuji Heavy Industries.

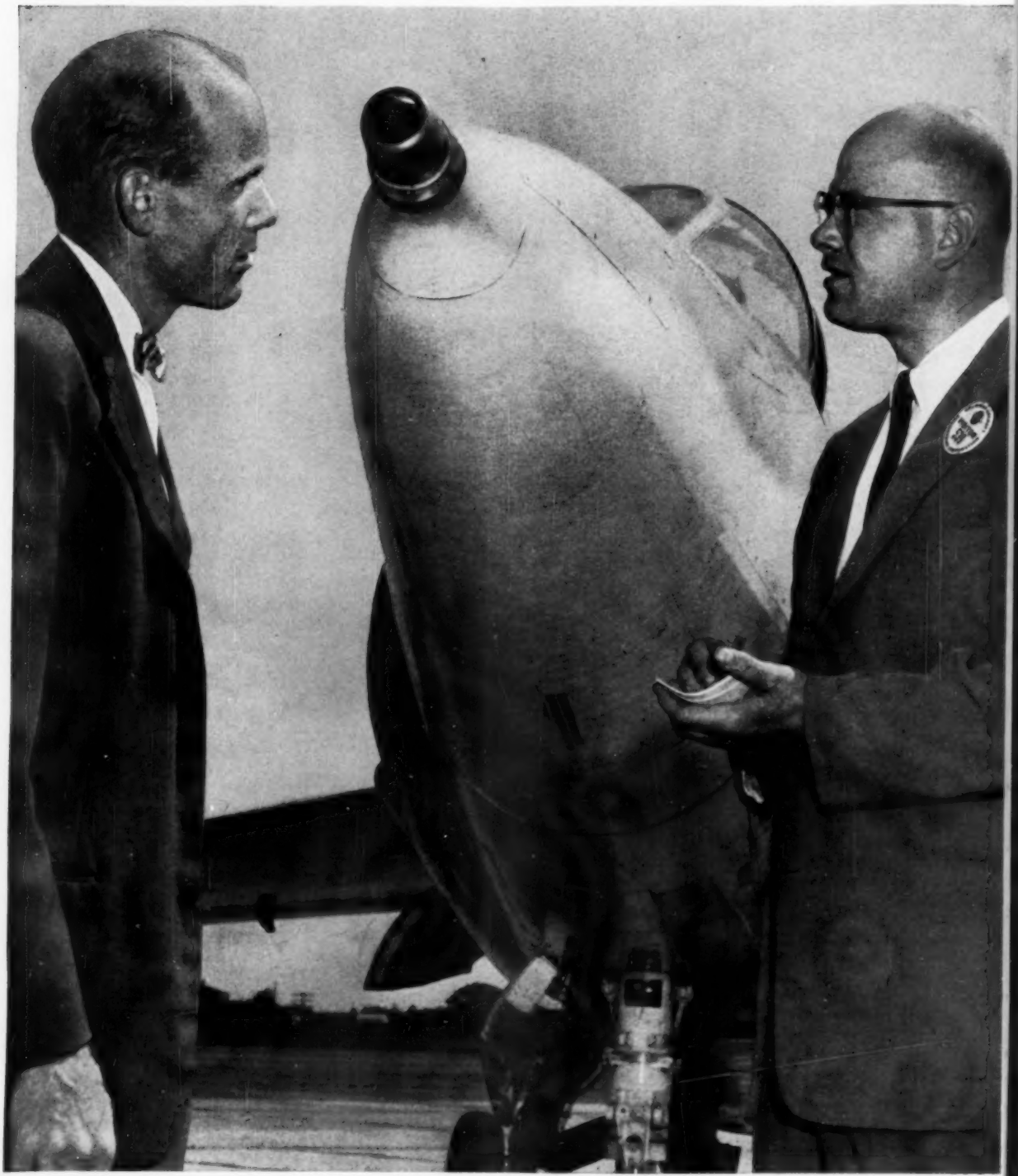
Ten Holste Broussard single-engine utility aircraft will be acquired by the Argentine Government from the French manufacturer. To date Avions Max Holste has sold 325 of the planes to French and foreign buyers.

C-47 conversion has been delivered by Timmins Aviation, Ltd., Montreal, Canada, to Transports Aeriens Intercontintentaux, Paris. Timmins recently sold a Royal Gull amphibian to the Quebec Provincial Department of Lands and Forests.

New Zealand Spray Planes

Fertilization of large tracts of poor soil by airplane receives strong backing of New Zealand government. From top to bottom, a Grumman Avenger, Fletcher Utility and a de Havilland Tiger Moth are loaded, the latter pair from a special mobile hopper which loads the plane in half-a-minute while the pilot keeps the engine running.

His Story Line is Born



Reading from left to right: Larry Mead, Project Engineer for Grumman Aircraft Engineering Corporation, the F11F-1 Grumman "Tiger" and Dave Anderton.

AVIATION WEEK has covered the "Tiger" since the first demonstration flights of this Navy fighter, which embodies the newest aerodynamic design principles.

on the Flight Line

Dave Anderton, Assistant Managing Editor of AVIATION WEEK,

Builds Top-Flight Reporting on First-Hand Experience

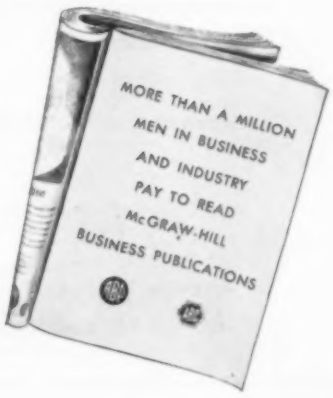
ON-THE-SPOT investigation is the policy that governs all technical reports which appear in AVIATION WEEK. In the past 12 months, Dave Anderton has made 38 trips into the field . . . visited every Research and Development Center of the USAF, covered missile development from New Mexico to the Bahamas—and many major aircraft plants here and abroad. 38 trips—38 stories for his magazine.

First foreign journalist to report on France's Dassault *Mystere* fighter, Dave even scored a beat on envious British journalists when he covered the Gloster *Javelin*, RAF operational fighter, while it still was an experimental project. Here at home, Dave lived—literally—at Boeing's Seattle plant during first flight tests of the 707 jet airliner.

He's just back from serving as a U. S. Delegate to the International Congress of Astronautics in Rome. At the same time, R. W. Martin, publisher of AVIATION WEEK, and Bob Hotz, Editor, were overseas for the airshow of the Society of British Aircraft Constructors; Hotz also attended the meeting of the International Air Transport Association in Edinburgh. Bill Jessup, Managing Editor, covered the Canadian International Air Show; Claude Witze, Military Editor, headed a five-man editorial team at the U. S. National Aircraft Show. No doubt about it—AVIATION WEEK editors get around!

In Dave's case, turning out definitive stories week after week comes naturally. Still in his thirties, he holds a Bachelor of Aeronautical Engineering degree from R.P.I., has served as a design engineer in prop-powered and jet-propelled aircraft projects. Before joining McGraw-Hill, Dave was project engineer for the *Hermes B* missile, and conducted a study on one ancestor of the ICBM—intercontinental ballistic missile.

Inside knowledge of the fields and problems of their readers is one of the reasons McGraw-Hill editors like Dave Anderton produce publications that lead in their fields. And McGraw-Hill has 485 full-time editors, backed by hundreds of correspondents, assigned to 34 publications. In the 16 specialized areas they serve, more than a million men pay to read McGraw-Hill magazines. They control specification and buying of your products and services . . . a market valued in billions of dollars that you reach for pennies per call with your advertising placed in McGraw-Hill magazines.



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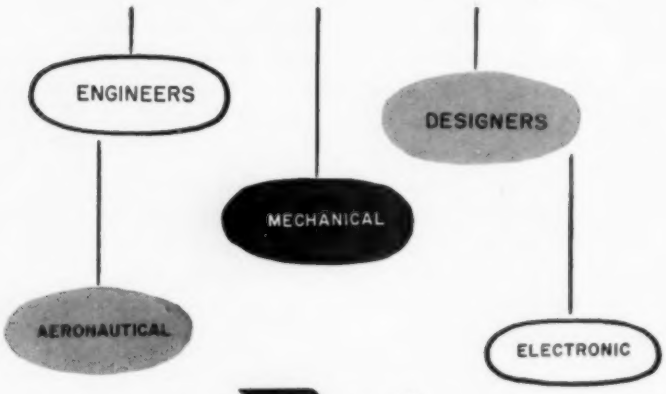

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Supervisor of Salaried Personnel

AC

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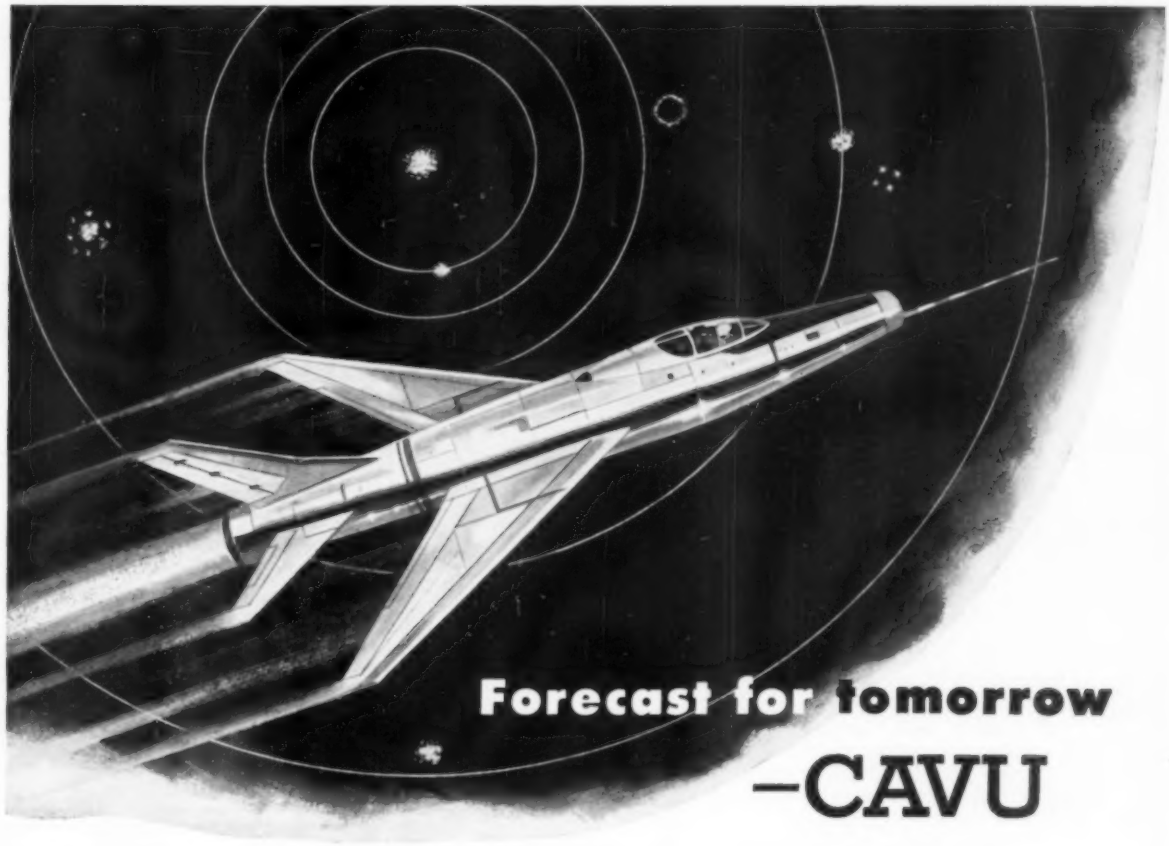

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we're in Milwaukee so we ought to know!

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- Aircraft Background desired.

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- Travel out of and headquarter in Wichita.
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- Must develop and administer a spare parts merchandising program.
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Contact
Personnel Dept.

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Write in confidence to:
P-3355, Aviation Week
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Now unique opportunities exist for talented men to develop controls for new product line of advanced small turboshaft, turboprop and turbojet engines.

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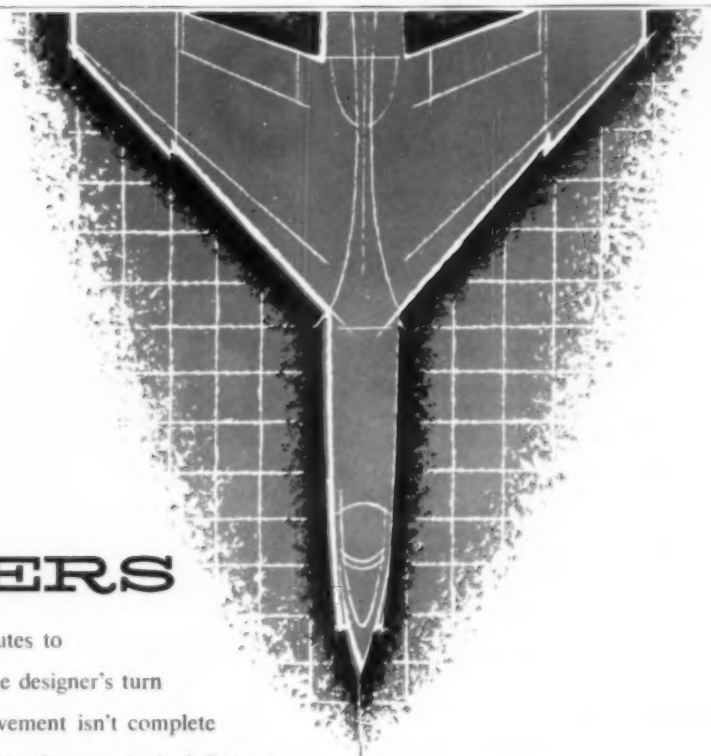

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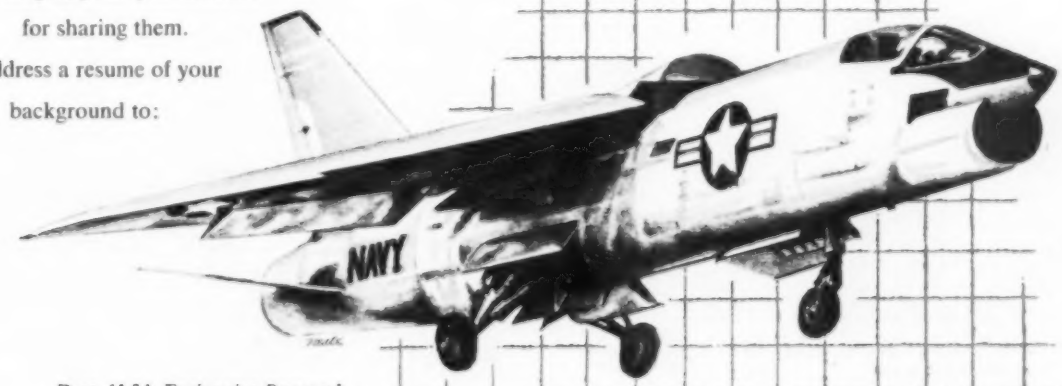
For every engineer who contributes to aircraft there's a time to take a bow. The designer's turn comes last, however, for his achievement isn't complete until initial production begins. And then it's often overlooked. But not at Chance Vought. Here, the designer stays with his creation, from drawing board to fabrication . . . from test to production. He's there for his final bow. This opportunity to see an idea through to completion is just one advantage a Vought designer enjoys. Discover them all, and investigate your qualifications for sharing them. Address a resume of your background to:



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P-3361, Aviation Week
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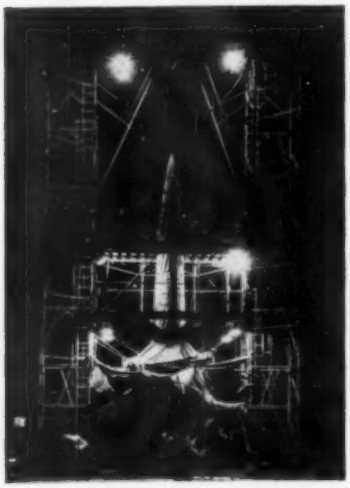

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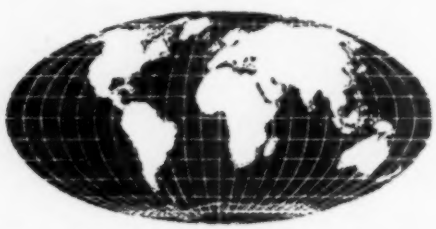

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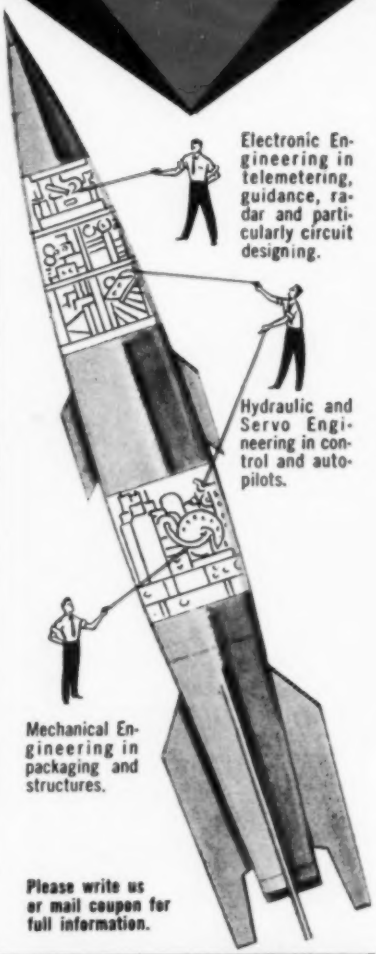

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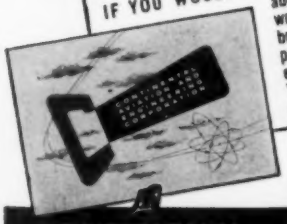

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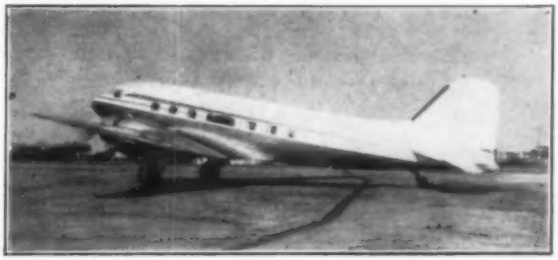

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ADMIRAL CORPORATION (GOVERNMENT LABORATORIES DIV.) 10
Agency—Cruttenden & Eger Associates

ADVANCED PRODUCTS COMPANY THE.....115
Agency—E. J. Lush, Inc.

AIRWORK CORPORATION 83
Agency—Gene Wyble Advertising

ALUMINUM CO. OF AMERICA 58
Agency—Fuller & Smith & Ross, Inc.

AMPHENOL ELECTRONICS CORPORATION 84
Agency—Burton Browne Adv.

AMERICAN SCREW COMPANY 52
Agency—Sutherland-Abbott Adv.

AMERICAN WELDING & MFG. CO., THE..... 12
Agency—The Basfess-Kay Co.

ASSEMBLY PRODUCTS, INC. 79
Agency—George E. Duff Adv.

AVCO MANUFACTURING CORP. DEFENSE & INDUSTRIAL PRODUCTS 70, 71
Agency—Hilton & Rooks, Inc.

AUTONETICS DIV. NORTH AMERICAN AVIATION, INC. 130
Agency—Batten, Barton, Durstine & Osborn, Inc.

AVIATION WEEK 138, 139

AVIEN, INCORPORATED 53
Agency—Slater, Sadler & Associates

AVION DIV. ACF INDUSTRIES, INC. 95
Agency—Charles W. Curts Adv.

AXELSON MFG. CO. DIV. OF U. S. INDUSTRIES, INC. 3
Agency—Charles Reeves Advertising, Inc.

BARBER-COLMAN COMPANY 96
Agency—Howard H. Monk & Associates, Inc.

BELL AIRCRAFT CORP. 63, 77
Agency—Baldwin, Bowers & Strachan, Inc.

BENDIX COMPUTER DIV. BENDIX AVIATION CORP. 72
Agency—The Shaw Company

BENDIX PRODUCTS DIV., BENDIX AVIATION CORP. .....Third Cover
Agency—MacManus, John & Adams, Inc.

BOEING AIRPLANE COMPANY 129
Agency—N. W. Ayer & Son, Inc.

BOWER ROLLER BEARING DIV. FEDERAL-MOGUL-BOWER BEARINGS, INC. 86
Agency—MacManus, John & Adams, Inc.

BRIDGEPORT BRASS COMPANY (ALUMINUM DIV.) 101
Agency—Hazard Advertising Company, Inc.

BRISTOL AIRCRAFT LIMITED 42
Agency—Young & Rubicam, Inc.

CANADAIR, LTD 60
Agency—Walsh Advertising Co., Ltd

CARMA MANUFACTURING COMPANY 119
Agency—Franklin Associates Adv.

CEE-BEE CHEMICAL CO., INC. 55
Agency—The Ralph Yambert Organization

CELCO CONSTANTINE ENGINEERING LABORATORIES CO. 128
Agency—John Phillips Advertising Co.

CLEVELAND PNEUMATIC TOOL COMPANY...74, 75
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ELASTIC STOP NUT CORP. OF AMERICA..... 57
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Agency—Ockfitch, E. Prosch & Associates, Inc.

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HARNISCHFEGER CORP., WELDING DIV..... 78
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Agency—Silver & Dorce Co., Inc.

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Agency—Zimmer McClaskey Adv.

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Agency—Peter Hurst Adv., Inc.

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Agency—Foote, Cone & Belding

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JET PROPULSION LABORATORY (CALTECH).... 54
Agency—Frank Barrett Cole Adv.

KAMAN AIRCRAFT CORP., THE 126, 127
Agency—Charles Palm & Co., Inc.

KEARFOTT COMPANY, INC. 93
Agency—E. M. Freystadt Assoc., Inc.

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Agency—Gaynor, Colman, Prentis & Varley, Inc.

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MARQUARDT AIRCRAFT COMPANY (RESEARCH DIV.) 11
Agency—Heintz & Co., Inc.

MARTIN CO., THE GLENN L. (DENVER DIV.)....108
Agency—Vansant, Dugdale & Co., Inc.

McDONNELL AIRCRAFT CORPORATION..... 26

MENASCO MANUFACTURING CO. 14
Agency—The McCarty Company

MIT INSTRUMENTATION LABORATORY..... 64
Agency—Allied Adv.

MONADNOCK MILLS-UNITED-CARR FASTENER CORP. 115
Agency—H. B. Humphrey, Alley & Richards, Inc.

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Agency—John E. Fergason Jr.

RAMO-WOOLDRIDGE CORP., THE..... 36
Agency—The McCarty Company

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Agency—Taggart & Young Adv.

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Agency—Clinton E. Frank, Inc.

ROBINSON CO., RALPH C..... 79
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ROLLS-ROYCE LTD. 46
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SEARCHLIGHT SECTION 140-156

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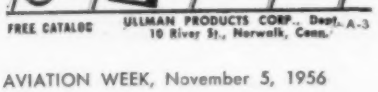

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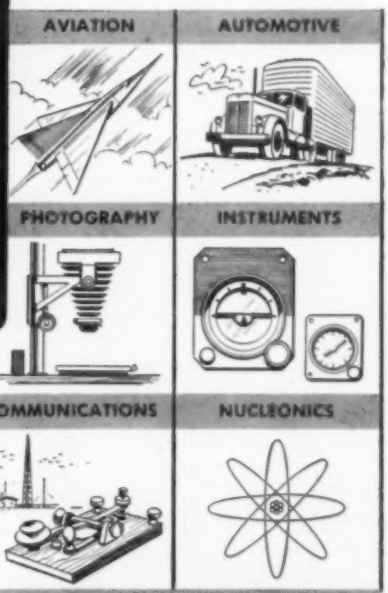

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LETTERS

Naval R&D

Your edition of AVIATION WEEK concerned with the Air Research and Development Command (Aug. 6) is a masterpiece of publishing. Persons concerned with naval aviation research and development are wondering if you plan an issue devoted to this field.

C. W. CRABB
Washington, D. C.

Equal Rights

I was amazed when I read Leo Kriloff's letter which appeared in AVIATION WEEK, July 30 (p. 102).

Apparently he has not paused long enough to think of the complications involved with 100% IFR, without the use of radar and the so called electronic marvels.

Has he any idea how small a portion of the total traffic we have today could be handled safely by ATC, with their present equipment and manpower? I doubt if they could expedite all of UAL's flights without causing a turmoil of delays. There are a few airlines that might want to obtain IFR clearances at the same time, plus several thousand corporate and business planes. Perhaps we shouldn't forget the many thousands of other planes that have an equal right on the federal airways in this free country of ours.

His military friend, W. P. Coleman, Jr. (AW, Sept. 3, p. 118), probably wouldn't be able to fly enough to draw his flight pay.

There are a lot of competent people in the CAA who have devoted years of study to this problem and have been frustrated year after year because Congress wants to give billions of dollars to the military but won't give the CAA the millions needed to streamline our airways.

Let's not insult the people that have worked hard to improve our traffic system and have always been stymied because of lack of funds. If 100% IFR would improve the situation they would have thought of and tried it long ago.

It would be wonderful if we could write checks as long as there are checks in our check book, but a lot of people with lots of intestinal fortitude found out it wasn't practical.

I have read and studied a lot of collision accident reports and in nearly all cases CAR (60.12C) was violated. That's being just as stupid as the automobile driver who disregards the stop sign or red light.

Recently, while on an IFR flight from HAR to MFD, we had to deviate our course on three occasions because it appeared we were on a collision course with other airplanes. Two of them were four engine airplanes and the third one was a DC-3. We did not assume that we had the right of way and we are thankful these planes were not coming from behind us where we couldn't see them. The third one occurred @ 2,500 MSL under the overcast, as we were approaching the MFD omni range. I was in the back seat of the Apache and noticed both pilots looking at something on the panel. I leaned forward to see what they were looking at, and in so doing scanned the horizon and saw the DC-3 boring in on us from about two o'clock. An extreme evasive maneuver on our part avoided a fatal accident. The crew on the DC-3 did not bother calling us to apologize, even though they were informed of the near miss.

Where were the four pilots looking? Not where CAR (60.12C) says they should have been. Also Flight Information Manual, ATC Procedures, Paragraph 5, page 60.

It seems that George M. Sager (AW July 30, p. 102) has the only practical solution that will keep us from colliding with each other until such time as the CAA can convince Congress it is just as important to keep people alive during peace as during war.

He should also scream to high heaven about the lack of visibility those "supposed to be safe" airplanes of his have (C. H. Sperry, AW Sept. 10, p. 166).

In the meantime let's all take CAR (60.12C) a lot more seriously, as I am sure we are all guilty of neglecting our best safety device.

A. CLAYTON TSCHANTZ, MANAGER
Mansfield Municipal Airport
Mansfield, Ohio

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Simple Solution

Your very fine magazine has recently carried letters and articles such as those from Capt. Leo Kriloff (AW July 30, p. 102), William Penn Coleman, Jr. (AW Sept. 3, p.118), and Capt. Robson (AW Aug. 27, p. 47) indicating 100% IFR is the solution to the current air traffic problem. I agree that this is a very simple solution to the problem, and probably would make life much easier for the professional pilots. Of course, this would have the practical effect of keeping all flyers without an instrument ticket out of the air, and so automatically most of the airplanes flying today would be kept on the ground. This, in itself, would eliminate a large number of accidents, and might even clear the air to such an extent that the professional pilots left could then continue to fly VFR much more safely than they now do and still continue not to look where they are going.

This logical method of saving lives could be carried outside the field of aviation. Why not pass laws which will effectively prevent all people using automobiles for pleasure and business from driving on the nation's highways? This would certainly make life much easier for the professional bus and truck drivers which would be left, and just think of the lives that would be saved! Over this past Labor Day weekend, more than 400 people were killed, most of them in passenger automobiles on pleasure trips, and if they all had been required to leave their automobiles in their garages, most of them would be alive today.

This simple and logical type of thinking is beginning to carry me away! Statistics show that many people are severely injured in falls while taking baths. Let's outlaw bathtubs and relieve the load on our hospitals even further!

Clearly, additional restrictive legislation and regulation would solve many of the problems which exist in this country today. Of course, we would then be violating the spirit, if not the letter, of certain provisions of the United States Constitution, but certainly, none could possibly object to this!

L. W. DARLING, Private Pilot
Davey Compressor Co., Kent, Ohio

Passenger's Gripes

The airlines and the ATC have now evolved the panacea, the cure-all, for the "no-show" problem. They are taking everything but giving nothing in return. I think it is time some attention be given to the passenger's gripes. Lest the airlines become over-awed with their own importance, I would remind them that passengers are their "bread and butter" and point to the experiences of the railroads when those organizations blandly ignored their passengers.

What about the "no-go" problem? Worse yet is the amazing consistency with which flights depart or arrive late. Then there are, of course, the minor inconveniences such as missed appointments, crushed luggage, over-booked flights, etc. I think it time a system of penalties be applied to the airlines for "no-goes" and lateness and that liabilities be substantially increased.

There can be no doubt that a "no-show" problem exists and it requires a solution, but is it really as bad as the airlines would have us believe? The "no-show" problem is particularly bad on the "popular" flights, but these also have the greatest number of wait-listings and stand-bys. I have often taken advantage of the situation to obtain a more convenient flight.

My work requires a substantial amount of travel. I make occasional trips to Los Angeles, Seattle, Dallas, St. Louis and more frequent trips to Washington, Buffalo, Dayton, etc. The longer trips are made four or five days in advance through the company travel office. The shorter trips are usually made on one or two days notice, wherein I pick up the tickets at the airport on a travel card thirty minutes before flight time. In four years I have missed only one flight. Perhaps this makes me unique, but I doubt it.

Speaking for myself, I am not about to drive thirty miles in an hour's time back and forth to Newark Airport a day in advance of every three hundred mile trip. Unless the airlines use a great deal of discretion, the train and my automobile will become more convenient to my travels. I am sure there are others with similar thoughts.

J. R. STANTON
Bloomfield, N. J.

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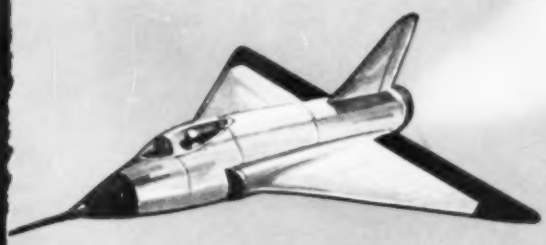

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